Introduction to Maintenance Procedures

The Series One and Series One Plus PCs are designed to provide trouble-free operation. However, occasionally situations requiring corrective action do occur and it is important to be able to quickly identify the source of such situations and correct them. Many times the need for corrective action originates outside of the PC.

Troubleshooting Aids

The advantages provided by the Series One and Series One Plus PC design are indicators and built-in aids to troubleshooting not only the PC, but also the overall control system. The main diagnostic tool is the programmer that can be easily attached to the PC. The programmer provides great insight to the status of the overall control system. When troubleshooting a Series One or Series One Plus PC based control system, make a habit of having a programmer with you.

Basic Troubleshooting Procedure

The following questions should be asked and appropriate action taken to negative answers. At the end of the list of questions are step by step procedures to be followed to replace various modules in a Series One or Series One Plus PC. All major corrective action can be accomplished by replacing modules. No special hand tools are required except for a screw driver and voltmeter. There is no requirement for an oscilloscope, highly accurate voltage measurements (digital voltmeters), or specialized test programs. Refer to figure 7.1 for location of the referenced indicators.

1. Is PWR (Power) light ON? If not, measure power at the input voltage terminals (98-126 V ac or 195-252 V ac as appropriate) on racks using an AC source of power. For racks requiring a DC power source, measure the DC voltage between the +24 and O V terminals. If the appropriate AC or DC power is not present, locate the source of the problem external to Series One or Series One Plus PC. If the AC or DC power levels are correct but the PWR light is off, fuses should be checked, then replacement of the CPU rack if necessary.
2. Is CPU light OFF? If ON, check which error code is displayed, refer to table 4.1 for error code definitions and take appropriate action.
3. Is RUN light ON? If not, check for the cause such as the programmer in the PRG or LOAD position or programming errors. If RUN light is OFF and a programmer is not connected, or the programmer in in the RUN mode without an error code being displayed, replace the CPU module.
4. Is the BATT light ON? If yes, replace the battery. Since the BATT light is only a warning level, the program may be unaltered even if the battery is low. After replacing the battery, examine the program or test the PC operation. If a fault is located reload the program from tape recorded at the completion of initial system programming.
5. In multiple rack systems if the CPU is operating, the RUN relay can be very useful in verifying operation of the other power supplies. If the RUN relay is not closed (high resistance) check the AC or DC power supply as in step 1 above. Adequate AC or DC power and an open relay requires replacement of the rack.

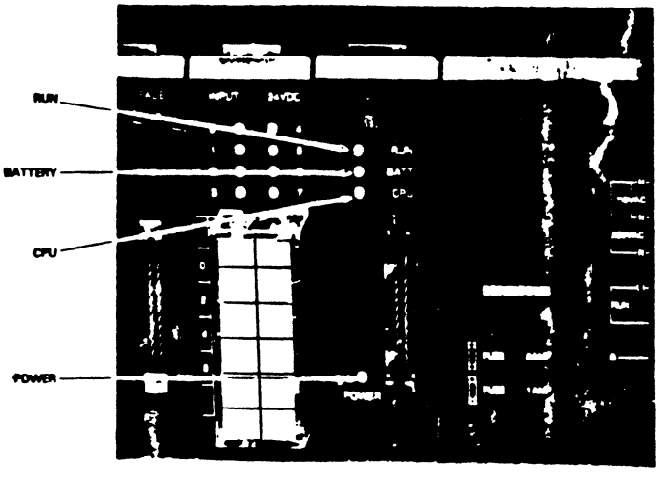


Figure 7-1. Troubleshooting Indicators

General Troubleshooting Procedure

Additional procedures depend upon knowledge of the logic installed by the user. The following steps are more general in nature and should be modified or adjusted as necessary to meet your specific application. There are no better troubleshooting tools than common sense and experience. First plug in the programmer and place it in the RUN mode, then follow these steps:

1. If the Series One or Series One Plus PC has stopped with some outputs energized or basically in mid-stream, locate the signal (input, timer, coil, sequencer, etc.) that should cause the next operation to occur. The programmer will display ON or OFF condition of that signal.
2. If the signal is an input, compare the programmer state with the LED on the input module. If they are different, replace the input module. If multiple modules in an expansion rack appear to require replacement, verify the I/O cable and its connection before replacing any modules.
3. If input state and LED on the input module agree, compare the LED status and the input device (pushbutton, limit switch, etc.). If they are different, measure the voltage at the input module (refer to Chapter 6 for typical I/O wiring). If the voltage indicates a problem, replace the I/O device, field wiring, or power source; otherwise; replace the input module.
4. If the signal is a coil wired to a field device, compare its status to the LED on the output module. If they are different, verify the source of field power to ensure excitation voltage is available. If field power is not present, examine the power source and its wiring. If the proper field power is available, but the status is wrong at the I/O module's output terminal, replace the output module or verify that the rack is providing the proper power to the module.
5. If the signal is a coil and either there is no output module or the output is the same as the coil state, examine the logic driving the output with the programmer and a hard copy of the program. Proceeding from right towards left, locate first contact that is not passing power that is otherwise available to it from immediate left. Troubleshoot that signal per steps 2 and 3 above if it is an input, or 4 and 5 if it is a coil. Ensure that Master Control Relays are not affecting operation of the logic.

6. If the signal is a timer that has stopped at a value below 9999, other than 0000, replace the CPU module.
7. If the signal is the control over a counter, examine the logic controlling the reset first and then the count signal. Follow steps 2 through 5 above.

Replacement of Components

The following procedures provide details on procedures to be followed when replacing components of a Series One or Series One Plus PC system.

Replacing a Rack

1. Turn OFF power and remove the programmer (if installed).
2. Remove the plastic cover and disconnect power wiring from the terminal board on the lower right side of the rack.
3. Remove all I/O modules. I/O wiring does not have to be disturbed if service loop was provided during the original installation. Note the position of each module in the rack for proper reinstallation.
4. Remove CPU module (if installed) and any filler modules. Place them aside in a safe location for later reinstallation.
5. Remove bottom two bolts holding the rack in place. Loosen but do not remove the top bolts.
6. Slide base unit up and then pull forward to clear the top mounting bolts. Set the rack aside.
7. Reinstall the new rack onto the top mounting bolts.
8. Insert bottom bolts and tighten all four mounting bolts.
9. Install the I/O modules in the same slots from which they were removed.

WARNING

Placing a module in the wrong slot can cause incorrect and dangerous operation of the control system.

10. Install the CPU and any filler modules that were removed.
11. Reconnect power wiring to the terminals on the right side of the rack. Reinstall the plastic cover over the power terminals.
12. Verify proper power wiring and then turn power ON. Carefully check operation of the entire system to ensure that all I/O modules are in their proper locations and the program is not altered.

Replacing a CPU Module

1. Turn OFF power and remove the programmer (if installed).
2. Squeeze the CPU module at the front, top and bottom to release securing tabs.
3. Pull the module straight out from its slot.
4. If PROM memory had been installed in the CPU, remove the PROM and install it in the new CPU.

5. Insert the new CPU module by first aligning the printed circuit boards into the bottom board guide.
6. Rotate the module upwards slightly to engage the top board guide.
7. Push the CPU module into the rack until both tabs snap into place.
8. Reinstall the programmer and reapply power.
9. Reload the program from tape recorded after initial system programming. Check operation of entire system.

Replacing I/O Modules

1. Turn OFF power from both the rack and the I/O system.
2. Remove the plastic cover from over the terminals on the I/O module to be replaced. Only field wiring on the defective module needs to be removed.
3. Disconnect field wiring from I/O terminals, detach the removable connector, or remove the connector to the I/O Interface cable, as applicable according to the type of module. Label each wire or note installed wire marking for future reconnection.
4. Squeeze the I/O module at the front, top and bottom to release securing tabs.
5. Pull the I/O module straight out.
6. Insert the new I/O module, aligning printed circuit boards first into the bottom board guide.
7. Rotate the module slightly upwards to engage the top board guide.
8. Push the module into the rack until both tabs snap into place.
9. Reconnect all field wiring, replace the removable connector board or replace the connector, then replace the plastic cover.
10. Reapply power to the CPU, then to the I/O system. Check operation of the system, especially the I/O module that was replaced.

Replacing the Battery

If the CMOS memory back-up battery requires replacement, refer to the following procedures. Figure 7.2 shows the battery location on the CPU, location of the battery connector and the battery tie-down straps.

a40289

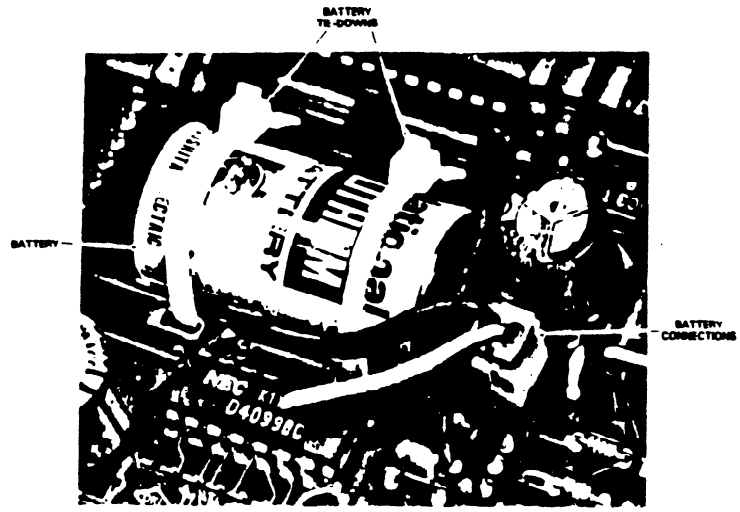


Figure 7-2. Battery Location and Connection

1. Remove the CPU following the previous instructions.
2. Cut the plastic tie down straps that secure the battery to the board.
3. Disconnect the battery. There is sufficient capacitance in the system to retain the CMOS memory contents even without the battery for about 20 minutes.

WARNING

The lithium battery should be handled with care. DO NOT discard the battery in fire. DO NOT attempt to recharge the battery. DO NOT short the battery. If these precautions are not followed, the battery may burst, burn or release hazardous materials.

4. Connect the new battery (catalog no. IC610ACC150) and place it in its proper position on the printed circuit board.
5. Secure with new tie downs or insulated wire.
6. Reinstall the CPU module.
7. Verify that the BATT light is OFF. If necessary, reload the CPU from a tape made after initial system programming. Then, check operation of the entire system.
8. If the two printed circuit boards that make up the CPU are separated, ensure that they are reconnected, installed in a rack, and powered up. Otherwise, logic may lock into a high current drain mode and prematurely drain the battery.

Adding Memory

The following procedure should be followed when adding memory to a Series One or Series One Plus PC. Either CMOS RAM memory can be added to increase memory capacity from 700 words to 1724 words or non-volatile PROM memory can be installed that contains a program previously entered into the PROM.

GEK-90842

a40290

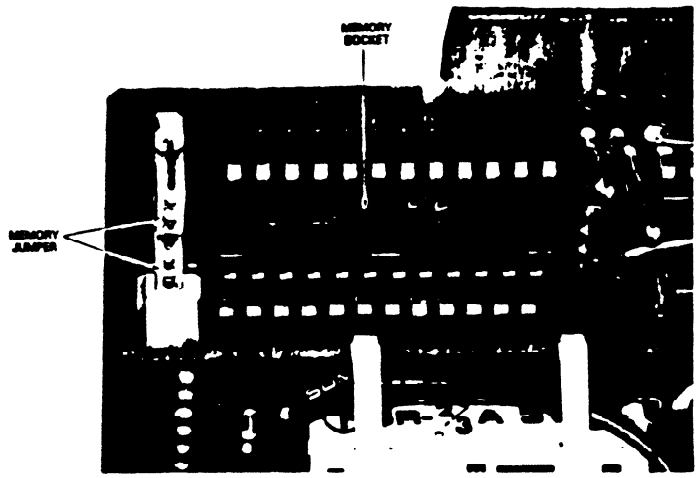


Figure 7-3. Location of Extra Memory Socket

1. Before installing additional memory, it is recommended that any program currently in memory be recorded on tape. If this is not done, the program will be lost after memory is added and a Clear All Memory operation is performed.
2. Remove the CPU following previous instructions.
3. Locate spare memory socket at the rear of the larger printed circuit board in the CPU.
4. Obtain the required memory IC either type 6116LP for Series One or 6264LP-15 for a Series One Plus, 2K x 8 bit CMOS RAM (or equivalent). If adding PROM memory, obtain an Intel type 2732A-2 for Series One or a 27256-25 for a Series One Plus (or equivalent PROMs). Ensure that the CMOS RAM or PROM is correct for your PC.

CAUTION

When handling CMOS memory ICs, always handle by the case and not leads. Static electricity on leads can damage internal circuits. This damage may not be apparent for several days or weeks of operation.

5. Orient the IC so that the notch at one end matches the notch in the memory socket.
6. For clearance when installing memory ICs, it may be necessary to lift the smaller printed circuit board 1/8" (3mm). Do not separate the boards. After the memory IC is installed, reseat the smaller board.
7. Insert the IC into the socket carefully and evenly so as not to bend any leads. Visually inspect to ensure that all leads are in place and then push down to firmly seat the IC. If necessary, readjust the jumpers and/or switch 2 as shown in table 3.2.
8. If the two printed circuit boards that make up the CPU are separated ensure that they are reconnected, installed in a base unit, and powered up. Otherwise, logic may lock into a high current drain mode and prematurely drain the battery.
9. Reinstall the CPU module following previous instructions.

10. Power-up the CPU, place the mode switch in the PRG position and perform a Clear All Memory operation (CLRSHF348DELNXT). The entire memory will now be entirely clear of data. Any program previously recorded on tape can now be loaded into the CPU from tape or a new program can be entered.

Spare Parts and Components

To support the Series One or Series One Plus PC, an Accessory Kit is available (IC610ACC120). This kit includes commonly needed components that may get damaged or lost in the normal course of operation. For a complete list of accessories for the Series One Family of programmable controllers, refer to GEP-762. Rather than attempting to place orders for plastic covers, fuses, audio cables, screws, etc., this kit can be ordered and provides sufficient material to support 3-5 CPUs depending upon their I/O count. Included in the kit are the following items:

ITEM	QTY.	ITEM	QTY.
Cable, Programmer to Tape Recorder	1	Fuses, 2A SB (Spiral Element)	3
Cable, Programmer to Peripheral	1	Fuses, 3A FB	5
Cover, CPU Connector	1	Fuses, 3A SB	5
Cover (large), DCU, PROM Writer,	2	Fuses, 4A SB	3
Printer Interface		Fuses, 5A FB	3
Cover (small), DCU, PROM Writer,	1	Fuses, 10A SB	5
Printer Interface		Key, Hand-Held Programmer	1
Cover, I/O Terminal	4	Screws, PH (M3x5)	10
Cover, Power Supply Terminal	2	Screws, PH (M3x7)	10
Cover, Rack Dust	1	Screws, PH (M3x16)	10
Fuses, 1A SB	5	Spacer	3
Fuses, 2A SB	3		

When supporting a Series One or Series One Plus installation, it is recommended that spare modules be available on site. These are in addition to the Accessory Kit previously discussed. As a guide to your requirements, the following percentages are presented. As a minimum, one each of all modules is recommended. Depending upon a number of application related conditions (location, average weekly hours of operation, cost of downtime, etc.) more units may be justified.

UNIT	% SPARES
Base with Power Supply	15
CPUs	15
Input Modules (each type)	10
Output Modules (each type)	15
Programmers	10
Cables	10
Peripheral Devices	10

Figure 7-4. Accessory Kit for Series One/One Plus

Fuse List

Table 7.1 is a list of fuses used in Series One I/O modules.

Table 7-1. I/O Module Fuse List

I/O MODULE CATALOG NUMBER	CURRENT RATING (AMPS)	QUANTITY	CIRCUIT CONNECTION	TYPE OF FUSE
IC610MDL103	3 Amps	1	soldered	pico fb
IC610MDL104	10 Amps	1	fuse clip	miniature sb
IC610MDL115	3 Amps	2	fuse clips	miniature sb
IC610MDL151	3 Amps	2	soldered	pico
IC610MDL153	5 Amps	4	fuse clips	miniature fb
IC610MDL154	5 Amps	4	fuse clips	miniature fb
IC610MDL155	3 Amps	2	soldered	pico
IC610MDL156	3 Amps	4	soldered	pico
IC610MDL157	3 Amps	2	soldered	pico
IC610MDL158	5 Amps	2	soldered	pico
IC610MDL175	5 Amps	2	soldered	pico fb
IC610MDL176	3 Amps	4	fuse clips	miniature fb
IC610MDL180	10 Amps	2	fuse clips	miniature sb
IC610MDL181	5 Amps	1	fuse clip	miniature
IC610MDL182	2 Amps	2	fuse clip	miniature sb
IC610MDL185	5 Amps	2	soldered	pico

Application 1 - One-Shots

This application is particularly useful when applied with a Series One PC, since with a Series One Plus PC, a one-shot can be programmed simply by entering the key sequence SET OUT RESET. In many applications, a signal is required that is valid for a very short time period. These signals are called one-shots and are generated by transitions (OFF to ON, or ON to OFF) of a control signal. They are valid for exactly one scan, which is the shortest signal available within the Series One and Series One Plus PCs. Timing for typical One-Shots is as follows:

pc-s1-83-0040

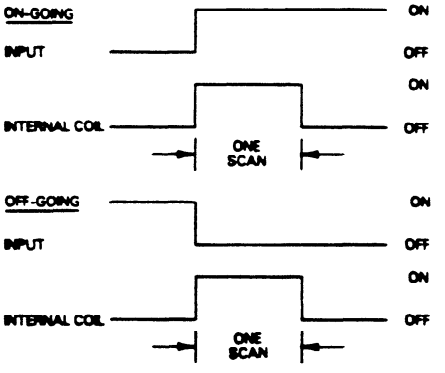


Figure 8-1. Typical One-Shot Timing

In this example, input 01 is the control signal and coil 160 the resulting one shot. Logic for these one-shots is shown below.

pc-s1-83-0041

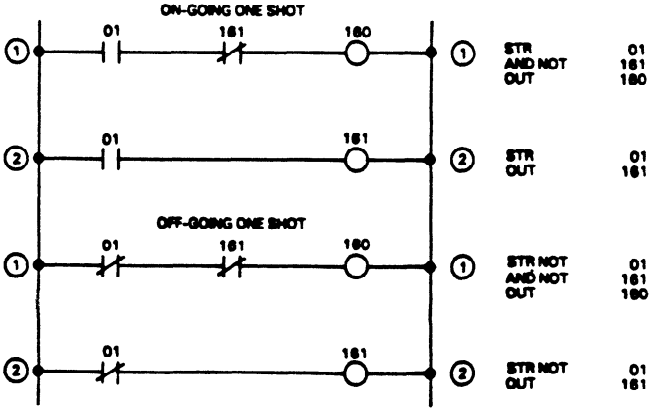


Figure 8-2. Typical One-Shot Logic

Application 2 - Flip Flop

This logic reverses states (ON/OFF/ON/OFF, etc.) each time a control signal is energized. In this example, the Flip/Flop changes state on the OFF to ON transition of the control signal. A typical timing diagram is as follows:

pc-s1-83-0042

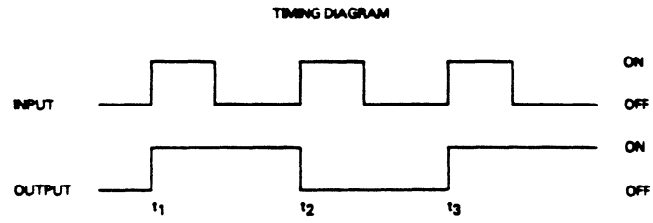


Figure 8-3. Typical Flip-Flop Timing Diagram

In the following typical logic, input 01 is the control signal and output 20 is the flip/flop.

pc-s1-83-0043

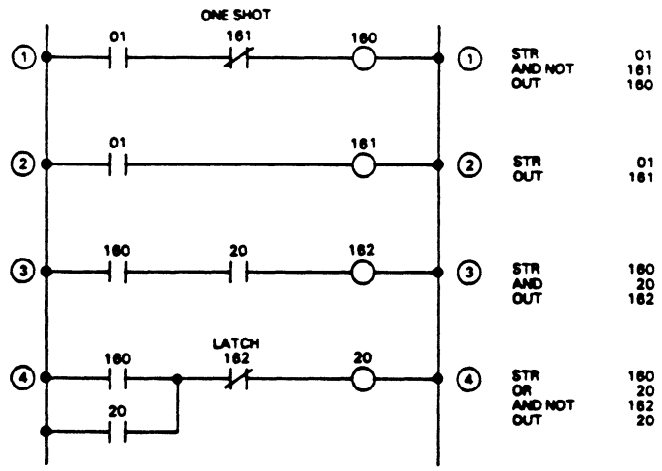


Figure 8-4. Typical Flip-Flop Logic

Application 3 - Event/Time Drum

Many control requirements can be defined as a sequence of established states for each output. The decision to shift from one step to another can be based upon time or specific input states. To illustrate this concept, the following 6 step example is provided. The control on incrementing the step is a confirmation of both events (for example, input 11) and a time value (for example, timer 601).

Step Number	Input	Time	20	21	22	23	24	25	26	27
1	10	T600	0	1	1	0	1	1	1	0
2	11	T601	0	0	0	0	1	0	0	1
3	12	T602	0	1	1	1	0	1	1	0
4	13	T603	1	1	1	0	0	0	1	0
5	14	T604	1	0	1	1	1	1	1	1

Each step can have different output states and more or less control can be implemented as the application requires. The ladder diagram required to implement this function is as follows:

pc-s1-83-0046

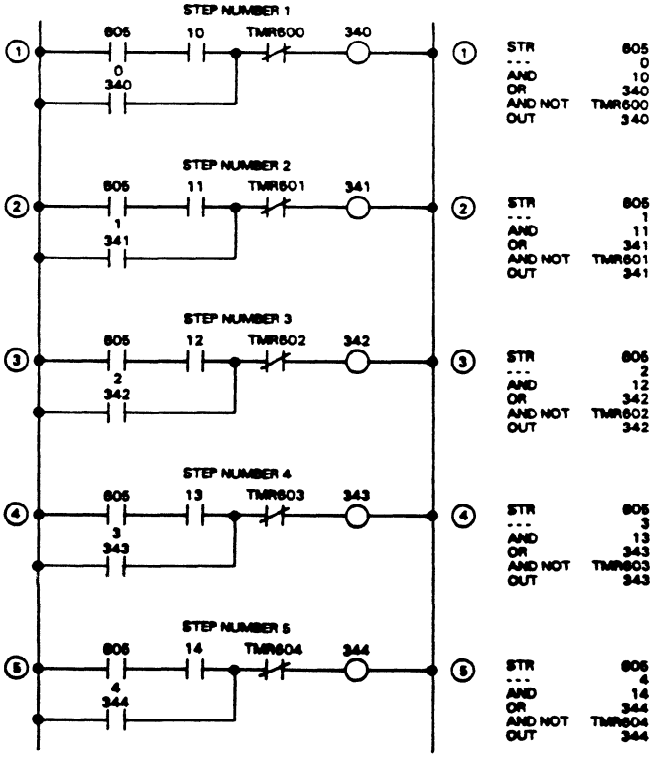


Figure 8-5. Event/Time Drum Logic

pc-s1-83-0047

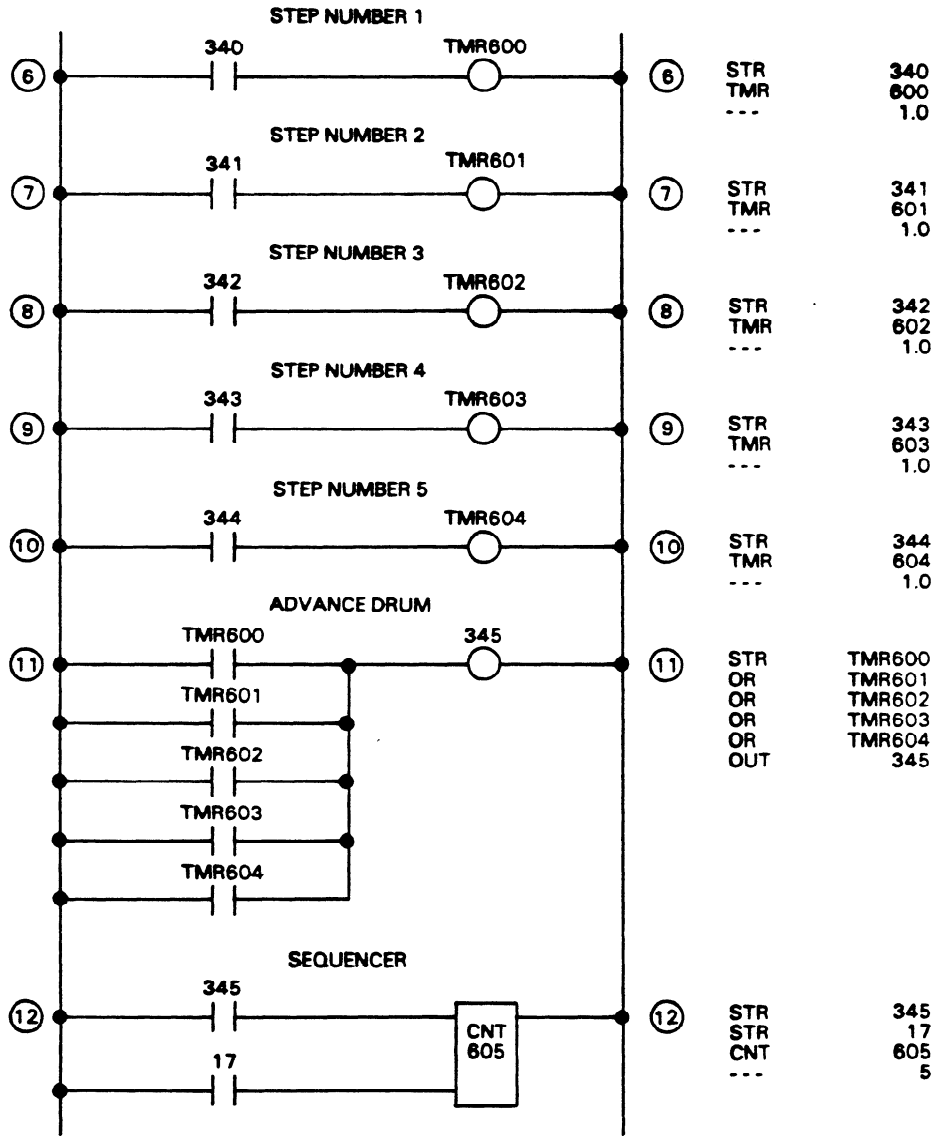


Figure 8-5. Event/Time Drum Logic (Continued)

pc-s1-83-0048

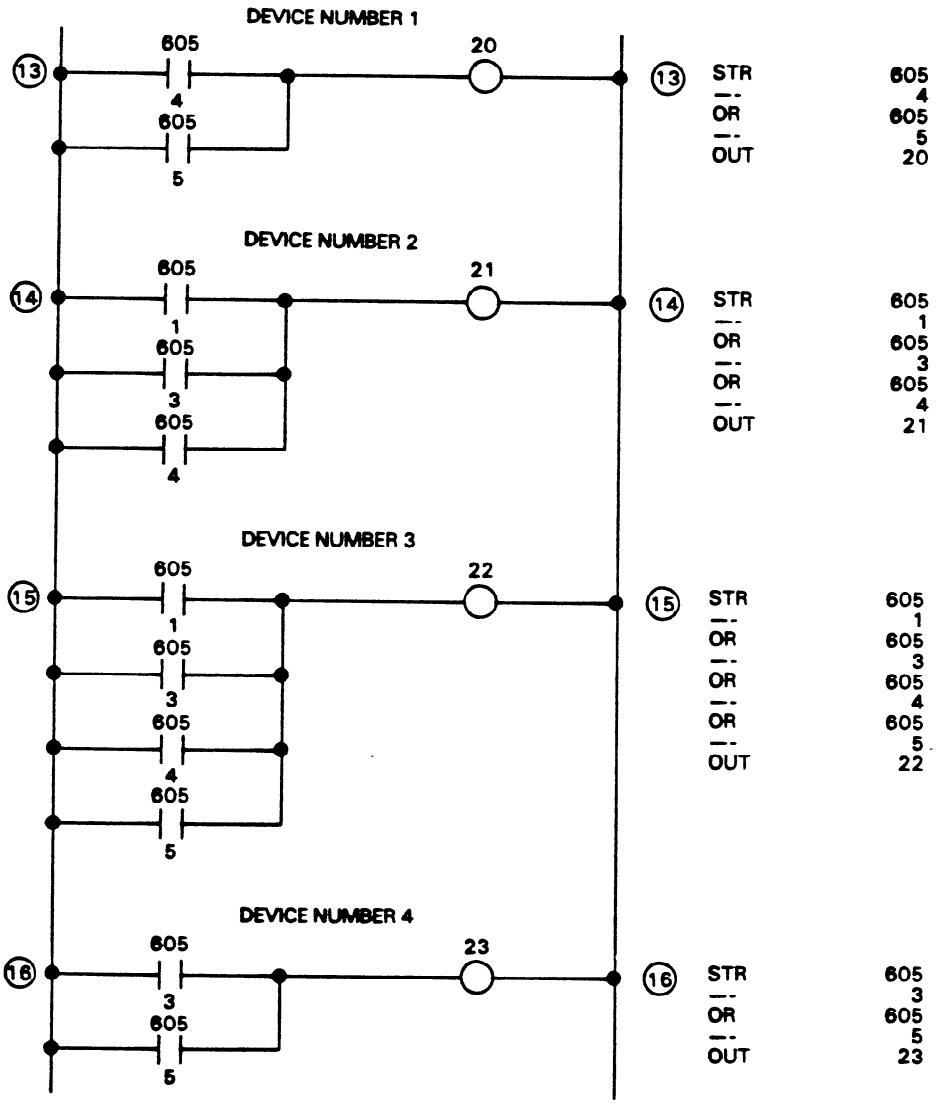


Figure 8-5. Event/Time Drum Logic (Continued)

pc-s1-83-0049

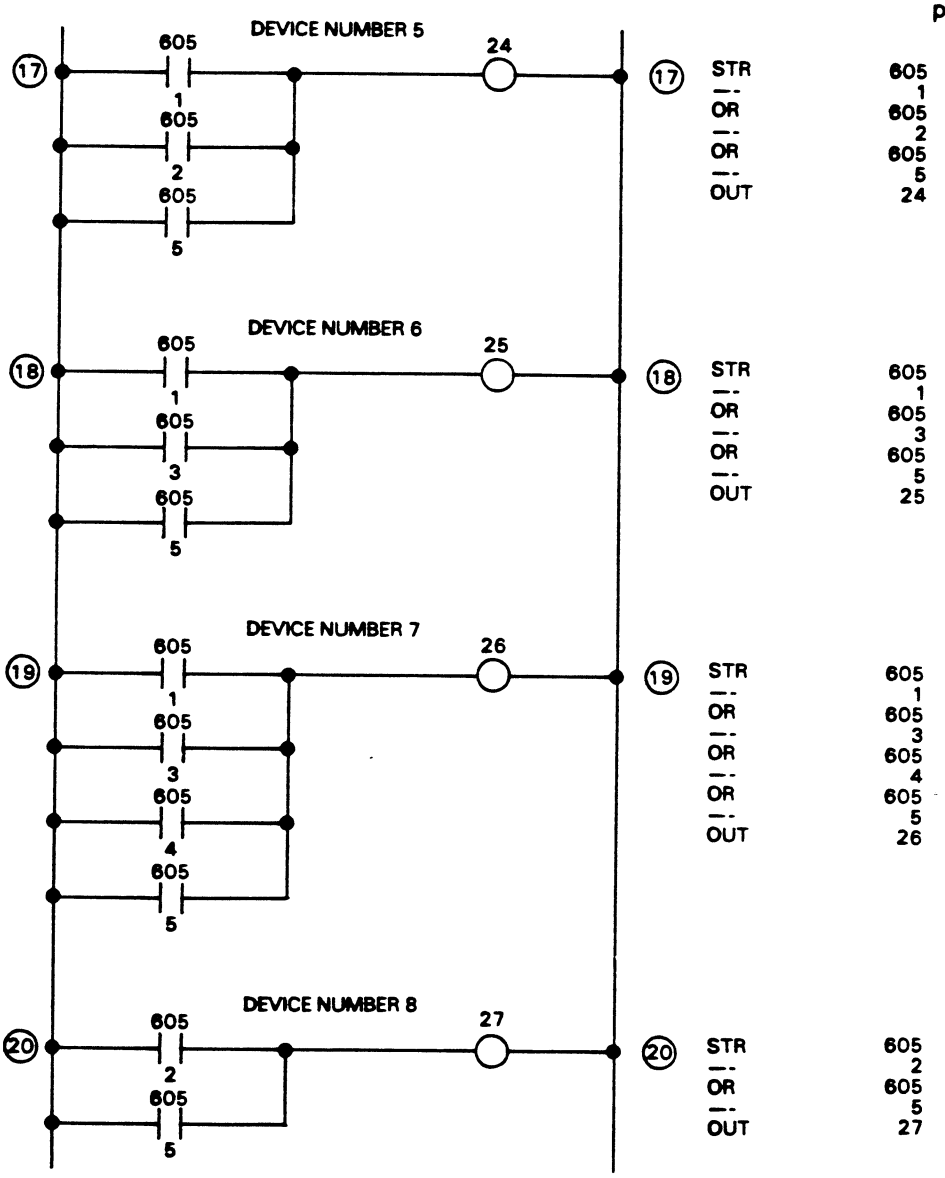


Figure 8-5. Event/Time Drum Logic (Continued)

Application 4 - Cascaded Counters

If an application requires a counter with presets greater than 9999, multiple counters can be assigned to that function. Two counters can record values up to 99,999,999 and three up to 999,999,999,999 etc. Additional logic is incorporated to generate a reset signal at 10,000 counts instead of the normal 9999.

The following logic uses two counters to record up to 99,999,999 events. Counter 601 records the low order values (thousands, hundreds, tens, and units) and counter 602 the high order values (tens of millions, millions, hundreds of thousands, tens of thousands).

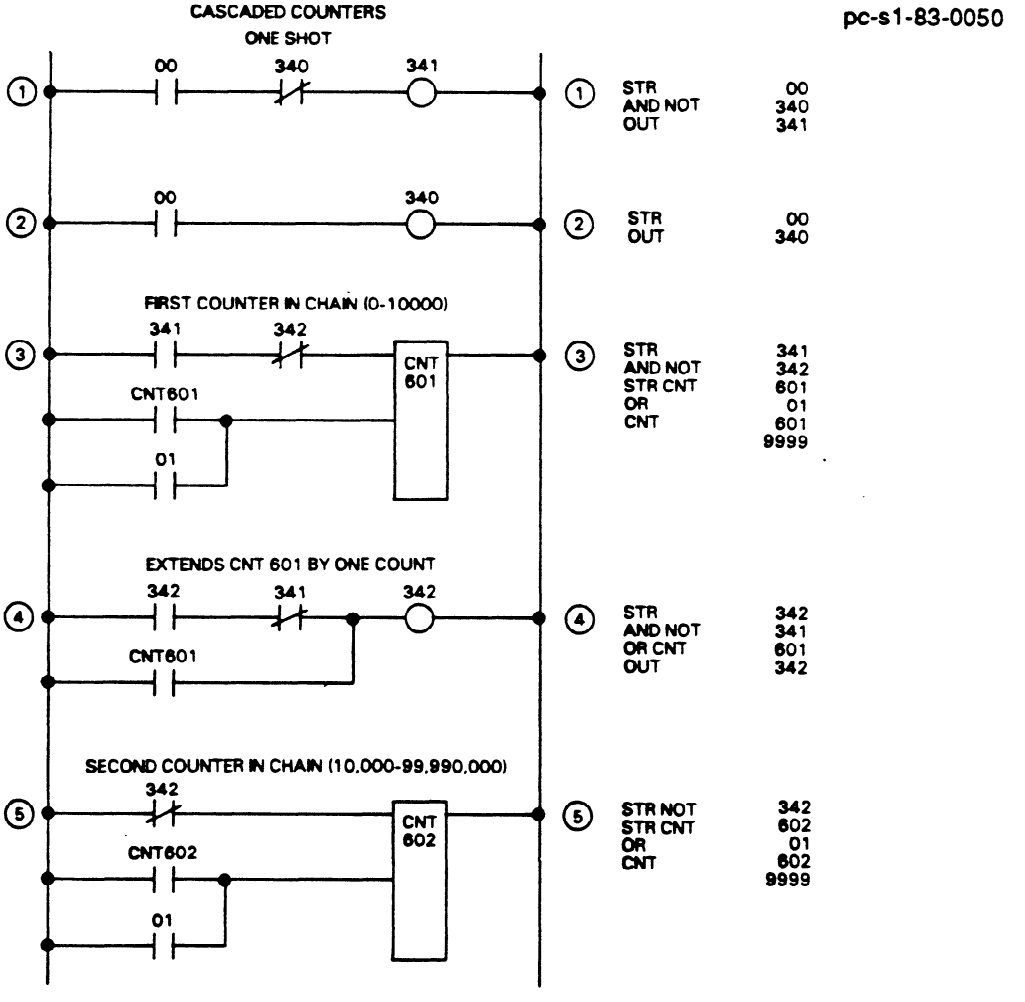


Figure 8-6. Sample Cascaded Counter Logic

Application 5 - Coil 374, Power-Up One-Shot

In industry, power loss to machines and process equipment is a frequent event. When such an event occurs it creates havoc with automatically controlled equipment and processes. The moment power returns it may be desirable to place the machine or process in a "hold" state until verification or critical limits, position of moving parts, and support equipment interfaces are confirmed to be correct by authorized personnel.

Description of Operation

The Series One and Series One Plus PCs have a special function reference (internal coil 374) that provides a pulse during the first scan only after powering up the CPU (or going from program to run mode). Using this pulse in the ladder logic, as shown below, will place the machine or process in the desired hold state.

The instant power returns to an automatic machine or process, certain phases (for instance, activating a cylinder, starting a motor etc.) of the automatic cycle need to be inhibited until a correct state is determined allowing the continuation of the cycle. The following program scheme will inhibit those critical outputs from activating field devices until a reset pushbutton is depressed, thereby, releasing all inhibited outputs and allowing the cycle to continue.

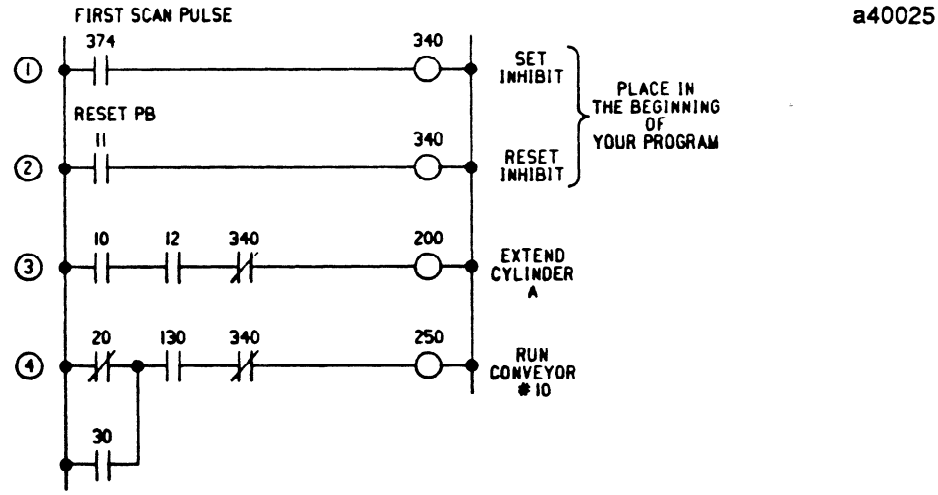


Figure 8-7. Typical Machine or Process Power-Up Inhibit Logic

The program logic in the above figure is an example you can use to inhibit certain phases of a cycle. In this example, when power returns to the process, 374 will be on during the first scan of the CPU, latching coil 340 on. The referenced NC contact of coil 340 is placed in series with the logic that actuates output coils 200 and 250. Even if the program logic is calling for coils 200 and 250 to turn on, they will not until 340 is unlatched. The only way to unlatch 340 is to depress the reset pushbutton (I100), allowing outputs 200 and 250 to be turned on.

Application 6 - Coil 375, 10Hz Clock

The Series One and Series One Plus PCs have a special function reference that continuously provides a pulse every tenth of a second. The following two examples use the function of this reference (10 Hz Internal Coil 375) to create a cumulative timer and a time of day clock.

Example 1: - Cumulative Timer

In this example, when reference 01 is on, time (in tenths of a second) would be accumulated by counter 600. If the time to be measured is anticipated to be larger than 999.9 seconds, cascading another counter will increase the range to 9,999,999.9 seconds. This technique allows you to measure the duration of an intermittent event that would otherwise reset the standard timer when changing state.

pc-s1-83-0078

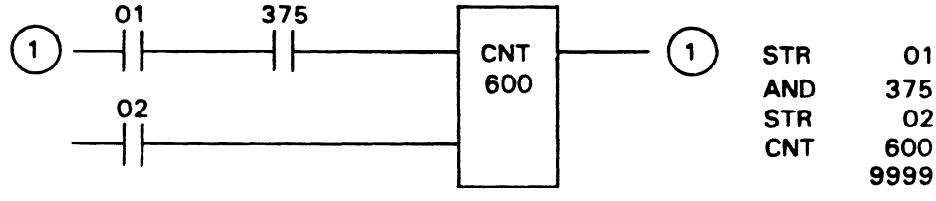


Figure 8-8. Cumulative Timer

Example 2: - Time of Day Clock

In this example, the 10HZ clock (Internal Coil 375) is used to program a time of day clock with reset capabilities. This is a 24-hour time clock, with the time format being XX:YY, where XX = hours (0-23) and YY = minutes (0-59). The 10HZ clock provides the 0.1 second pulse to counter 603 which in turn produces one pulse every second. The remaining three counters, 600, 601 and 602 keep track of seconds, minutes and hours that have elapsed. If power goes off and the clock needs resetting, the combined use of a 3 position switch and a pushbutton, as shown in Figure 8.10, will allow you to set the correct time. The lower portion of Figure 8.10 is the ladder logic which resets the clock. An I/O Simulator module, IC610MDL124, could also be used and programmed to reset the clock).

a40509

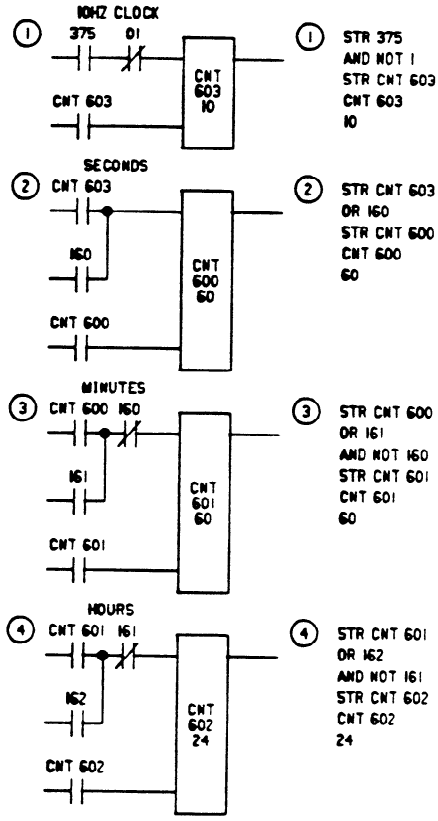


Figure 8-9. Sample 24 Hour Time Clock Logic

a40557

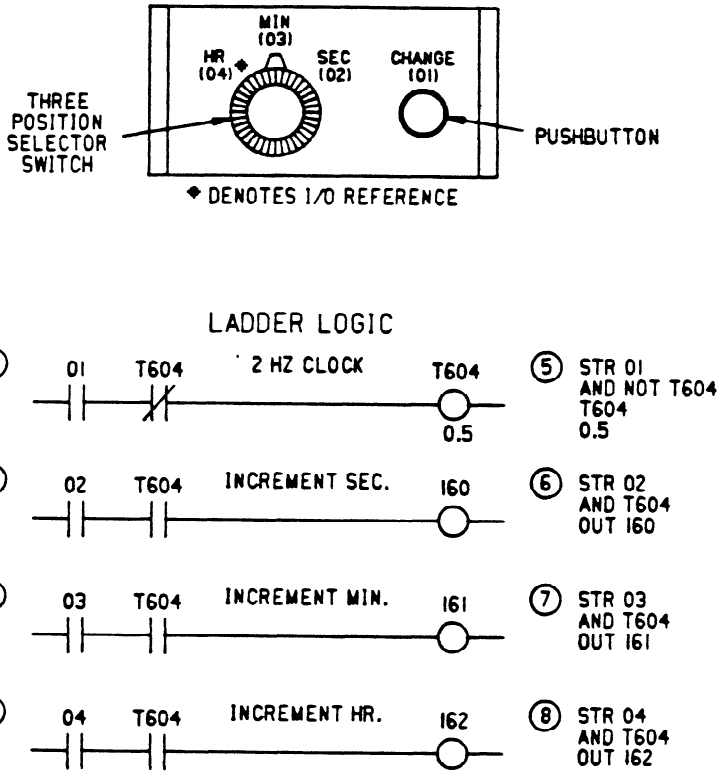


Figure 8-10. Time Clock Resetting

To reset the time, use the following procedure.

1. Select hours, minutes or seconds with the 3 position selector switch.
2. Monitor the appropriate counter.

   CNT 600: Seconds
   CNT 601: Minutes
   CNT 602: Hours
   Keystroke sequence is SHF, 6XX, MON
3. Depress the change button until the proper value (time) is displayed on the programmer.

Application 7 - Start/Stop Circuit

A simple but informative application for the Fast Response module is the Start/Stop circuit. In this example, Output 4 is in the Fast Response mode and is controlled by Inputs 0 and No. 1. The timing diagram shows worst case response times.

pc-s1-84-0018

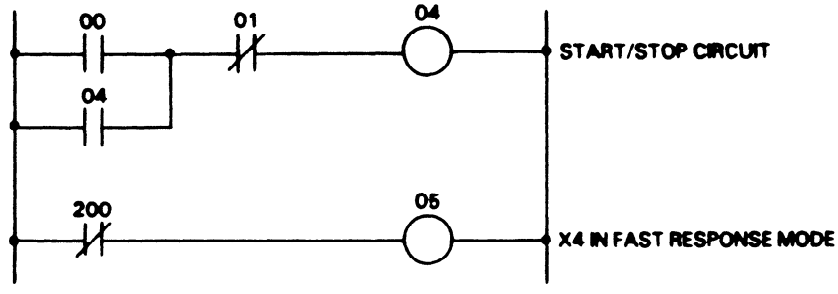


Figure 8-11. Fast Response Start/Stop Logic

I/O REFERENCE	DEFINITION
00	Enable output, X4 in fast response mode
01	Disable output X4 in fast response mode
04	Output X4 tied to field device being controlled
05	Mode select for output X4 DISABLED: manual mode ENABLED: fast response mode
200	Dummy contact to put output X4 in fast response mode

pc-s1-84-0019

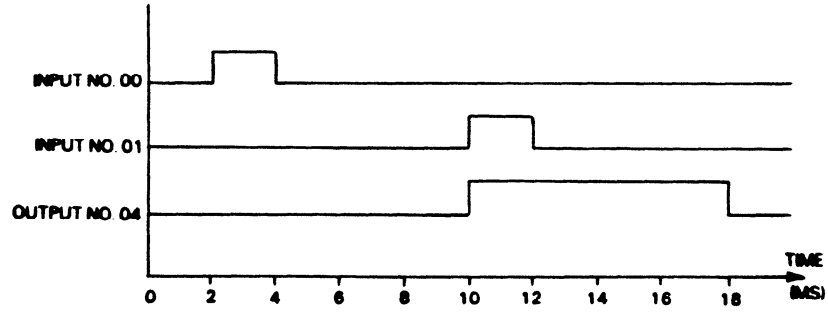


Figure 8-12. Worst Case Timing Diagram

Application 8 - High Speed Counter Applications

Three general types of application examples will be covered within this application.

1. Programmable CAM Switch
2. Cut to Length
3. Measurement of length

In the development of these applications the following system configuration will be used.

pc-s1-84-0010

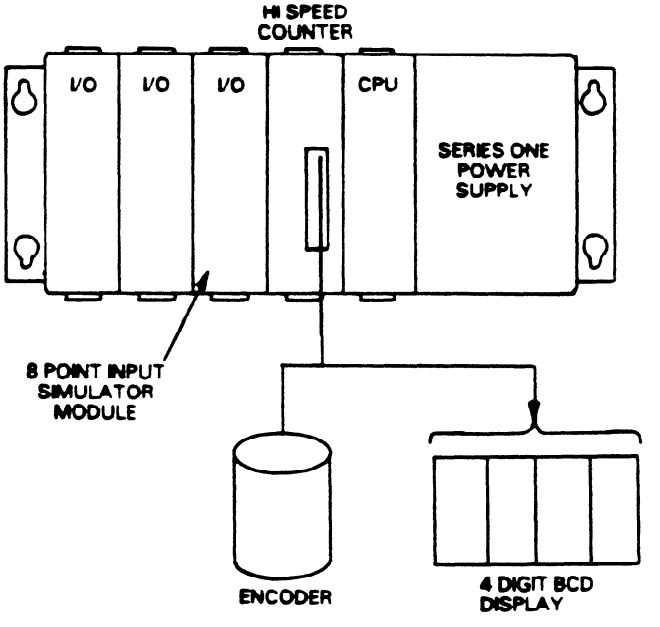


Figure 8-13. Application System

Programmable Cam Switch

The basic concept behind a CAM switch is to enable/disable certain devices at various points in the cycle of a machine. Using one or more high speed counters this type of control can easily be implemented. The following example illustrates this, cycling the high speed counter's two outputs at different preset values. The timing diagram below shows the output logic, with the user program necessary to implement this logic shown on the following pages. This example assumes that the encoder is resetting the counter once per revolution, and that the machine will not travel from one transition point to the next in less than twice the scan time.

a40023

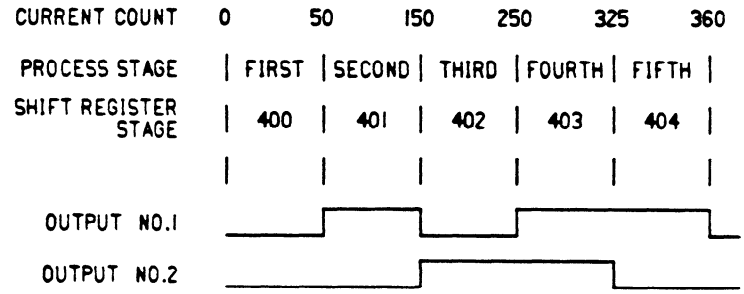


Figure 8-14. Programmable CAM Switch Logic Timing Diagram

a40893

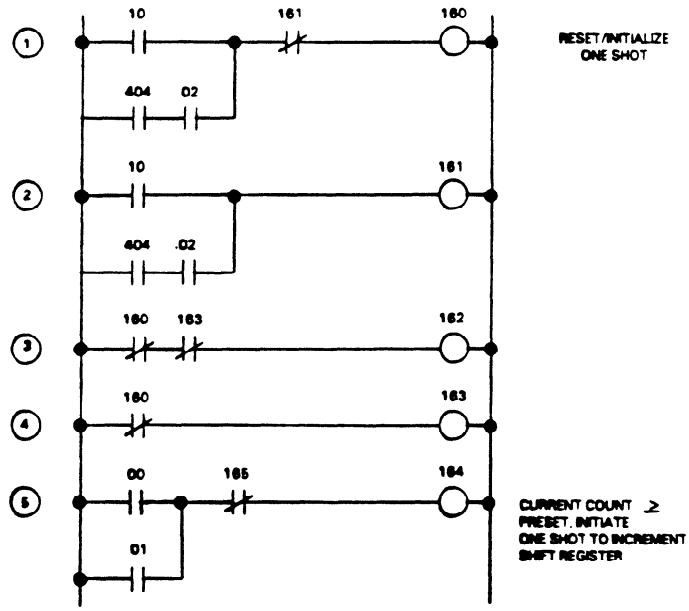


Figure 8-15. Programmable CAM Switch

a40893

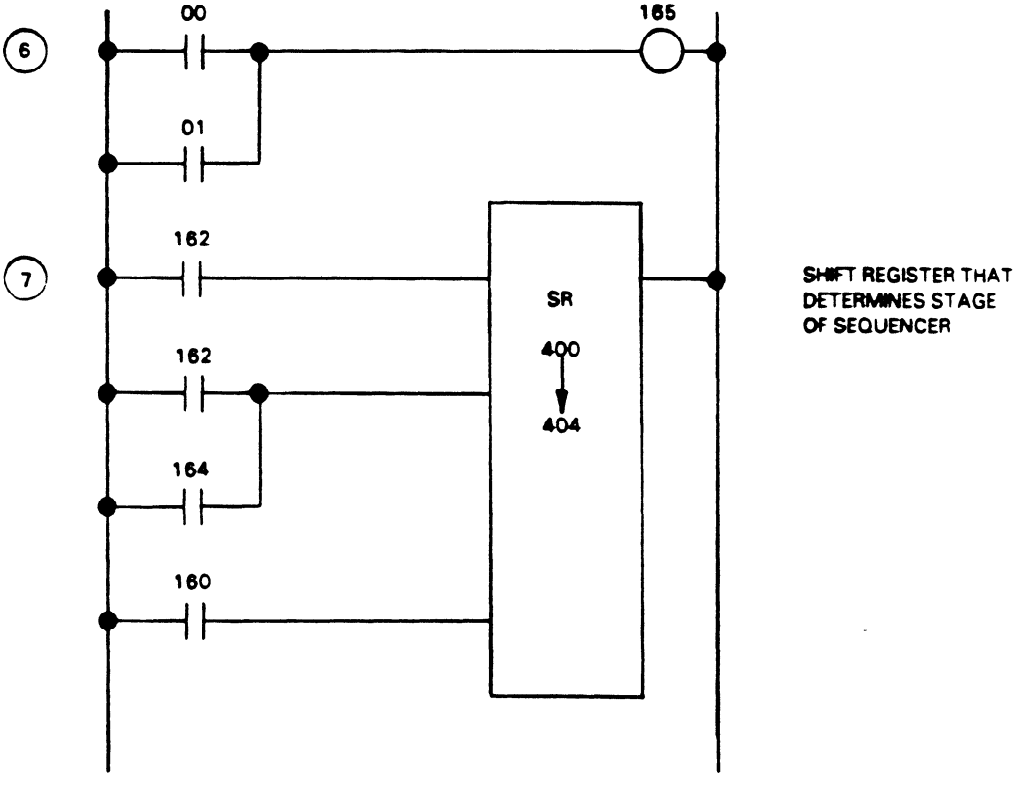


Figure 8-15 Programmable CAM Switch (Continued)

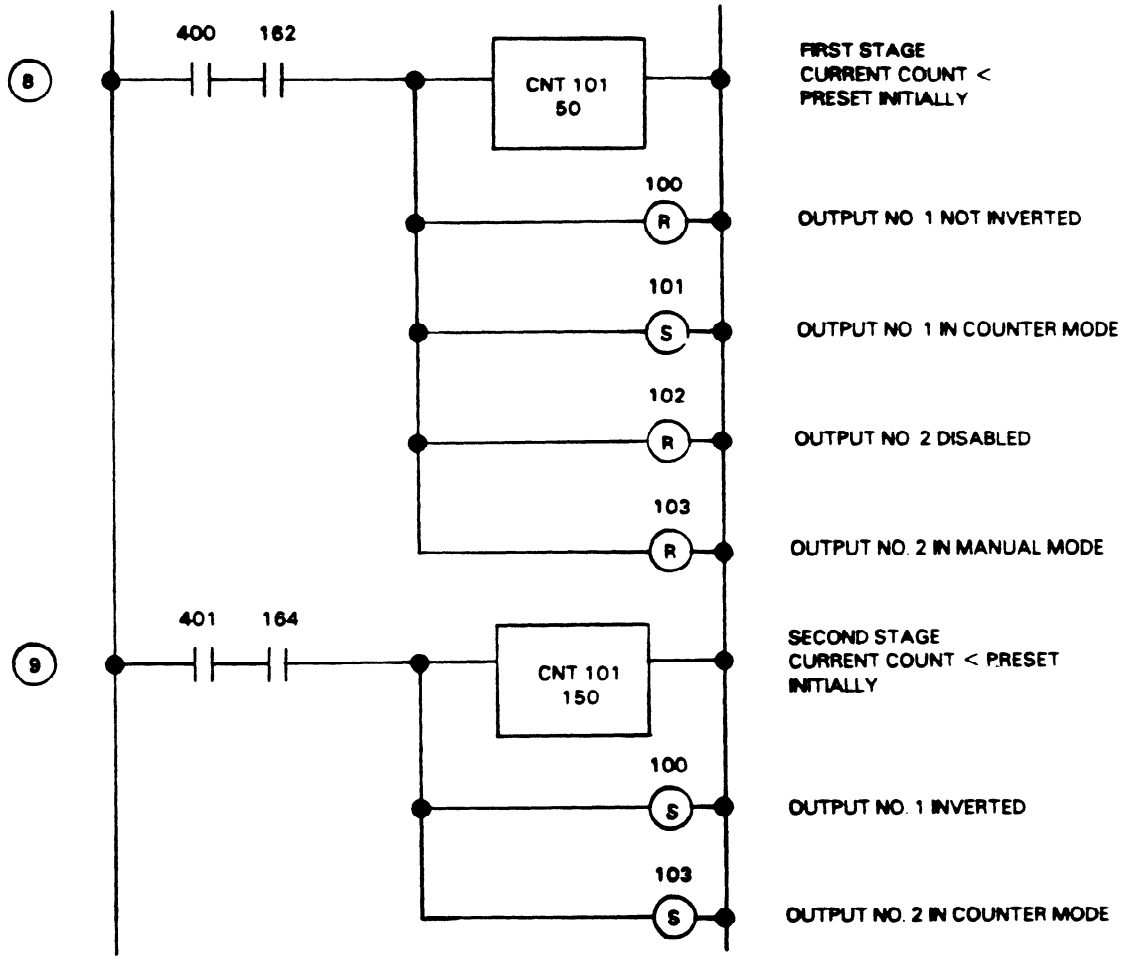


Figure 8-15 Programmable CAM Switch (Continued)

Cut to Length

With this type of control application the object is to generate a pulse output every X number of counts. In cut to length applications X represents the length of material to be cut in pulses from the encoder. The following example pulses output No. 1 of the High Speed Counter once every 100 counts. The figure below shows the logic diagram for output No. 1, while the next figure contains the wiring diagram for this type of application, followed by the associated ladder logic.

a40894

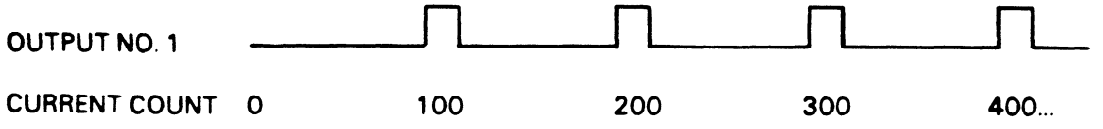


Figure 8-16. Output No. 1 Logic Diagram

pc-s1-84-0014

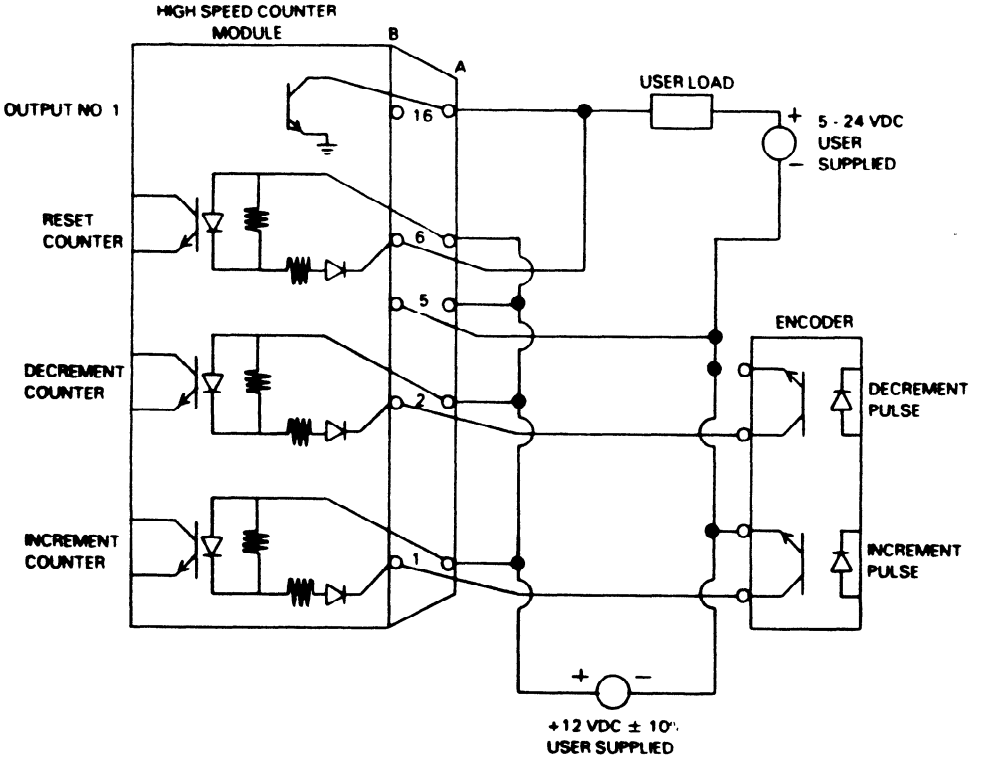


Figure 8-17. Wiring Diagram

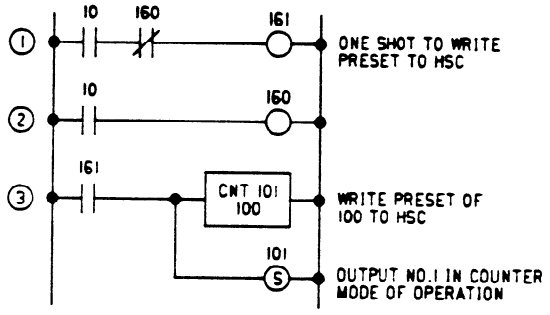


Figure 8-18. Cut to Length Program

Measuring a Random Length

In measuring the length of moving objects, the leading and trailing edge of the object enables and disables the counter which is tied to the encoder. At this point the accumulate value of the counter represents the length of the object. Unfortunately the accumulate value of the High Speed Counter cannot be moved into the user logic of a Series One or Series One Plus PC. Thus an objects length can only be measured relative (> = <) to a preset value in the counter. Through the use of a shift register and multiple presets, the length can be approximated to within two successive presets. To determine the accuracy a moving objects length can be measured. Three parameters must be considered:

1. Velocity of Object (pulses/second)
2. Resolution of Encoder (inches/pulse)
3. Scan time of the Series One or Series One Plus CPU (seconds) These three factors combine in the following manner to determine the accuracy of measurement.

$$\text{Accuracy of Measurement} = R \ \frac{\text{INCH}}{\text{PULSE}} \ V \ \frac{\text{PULSE}}{\text{SEC}} \ 1.1sc \ (\text{sec})$$

Sample Calculation

Given:

1. 0.1 inches/pulse
2. 60 RPM, assume 1 pulse/degree = 360 pulses/second
3. Scan time 20 msec

PULSE SEC

The user logic as shown would implement this type of measurement giving a resolution of 10 counts.

I/O Definition: I11 - Photoelectric cell which enables counter I10 - Manual Reset/Initialize

a40895

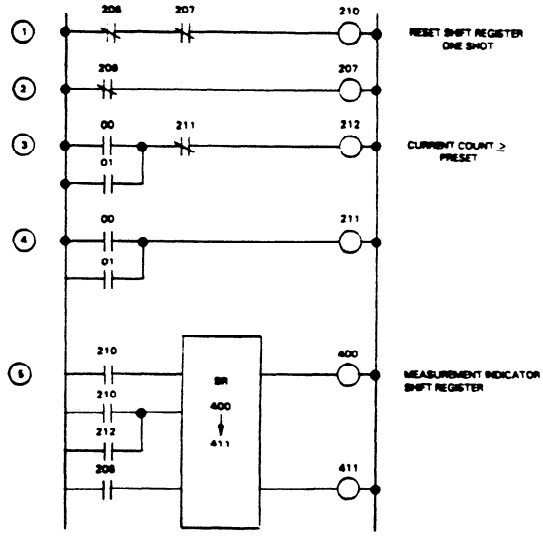


Figure 8-19. Measuring a Random Length

a40895

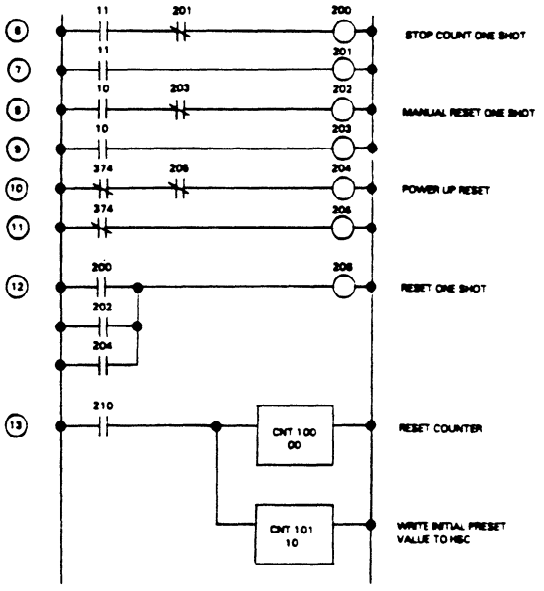


Figure 8-19 Measuring a Random Length(Continued)

a40895

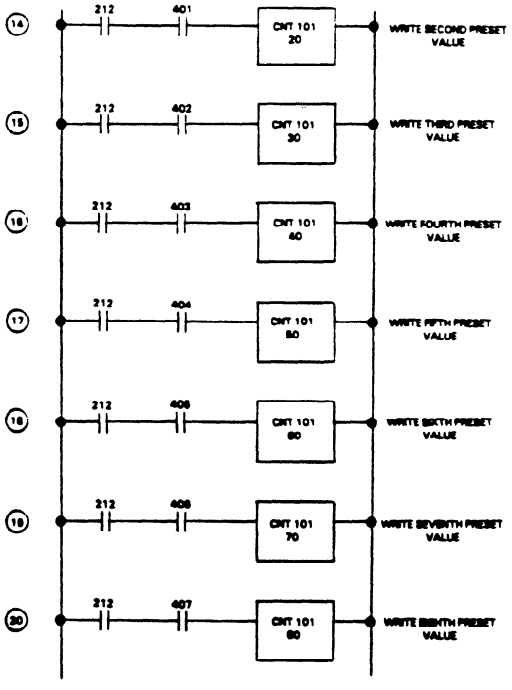


Figure 8-19 Measuring a Random Length(Continued)

a40895

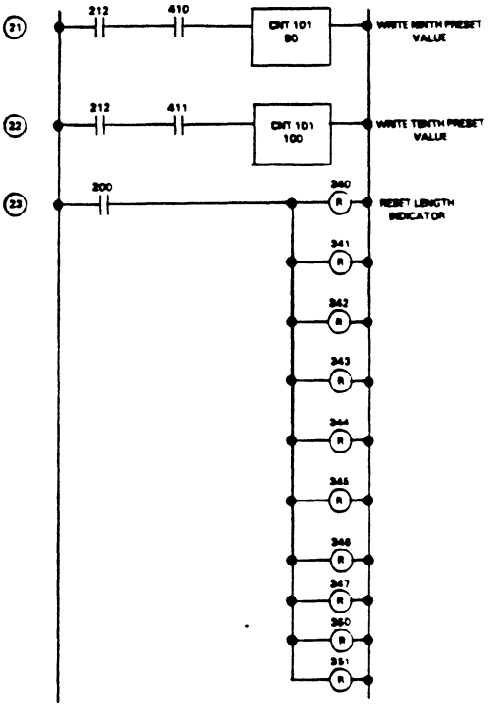


Figure 8-19 Measuring a Random Length(Continued)

a40895

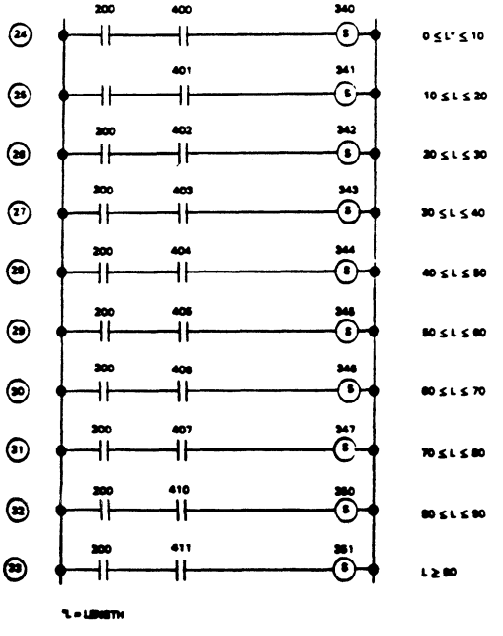


Figure 8-19 Measuring a Random Length(Continued)

Application 9 - Typical Shift Registers

When applying controls to a conveyor system or indexing machine, consideration must be given to the object being assembled, since it invariably has discrete information (pass, fail, etc.) associated with it. Each time that the object is advanced in the assembly process, its discrete information must follow it. The shift register function provides this control within the Series One and Series One Plus PCs.

Referring to the following example, the objects undergo a mechanical and visual inspection at stations Number 1 and 3. If either inspection fails, the object is rejected at station Number 5. In order to track the pass or fail status of each object, two shift registers are required, one for the mechanical inspection and one for the visual inspection.

pc-s1-83-0044

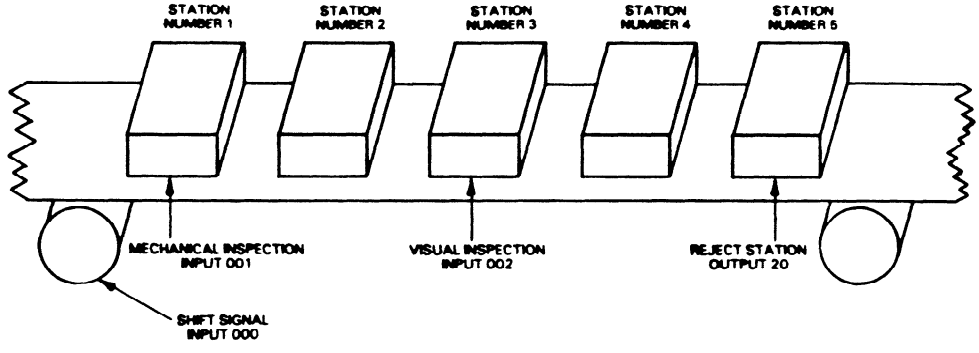


Figure 8-20. Shift Register Example

In this example, I/O and shift register references are assigned as follows:

	INPUTS		OUTPUTS
00	Advance belt, shift signal	20	Reject Arm 0 - Off 1 - On
01	Mechanical inspection 0 - pass 1 - fail		
02	Visual inspection 0 - pass 1 - fail		
03	Reset Shift Register		

Shift Register References

400 First reference in mechanical inspection shift register.

401 Second reference in mechanical inspection shift register.

402 Third reference in mechanical inspection shift register.

403 Fourth reference in mechanical inspection shift register

410 First reference in visual inspection shift register.

411 Second reference in visual inspection shift register.

Typical logic using these references is shown in the following ladder diagram.

pc-s1-83-0045

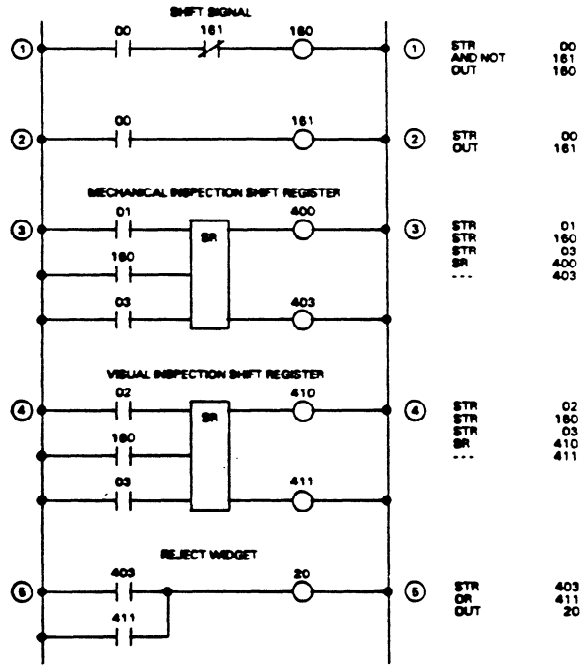


Figure 8-21. Typical Shift Register Logic

Appendix A
Related Documentation

Introduction

Several manuals are available that complement this manual. These manuals provide information required to fully implement certain features and options available for use with a Series One or One Plus programmable controller system. A basic description of the content of these manuals is provided in this appendix. The following manuals are available and along with this manual, constitute a complete set of documentation for a Series One or Series One Plus PC system.

GEK-90477 Series One/Three Data Communications Manual
GEK-90507 Remote I/O User's Manual
GEK-90825 Series Six PC I/O Link Local Module User's Manual
GEK-90846 Portable Programmer User's manual
GEK-96632 Logicmaster 1 Programmer Documentor Manual
GFK-0075 Logicmaster 1 Family Programming and Documentation Software

GEK-90477 Series One/Three Data Communications Manual

This manual provides information necessary to implement a serial communications link between a Series Six or Series Six Plus programmable controller (PC) or host computer and a Series One, Series One Plus, Series One Junior, or Series Three PC.

You should become familiar with the operation of the Series One, Series One Plus, Series One Junior, or Series Three PC (depending on your application) before reading this manual. Also, if a Series Six or Series Six Plus PC is to be included in your communications link, you may wish to refer to the Series Six Data Communications Manual, GEK-25364, for relevant information.

Chapter 1, Introduction, describes the capabilities of the Data Communications Unit (DCU) and the Data Communications Module (DCM) and possible system configurations of Series One, Series One Plus, Series One Junior, and Series Three PCs with a Series Six or Series Six Plus PC or host computer.

Chapter 2, Installation and Operation of the Data Communications Unit for the Series One, Series One Plus, and Series One Junior PCs, describes the operation of the Data Communication Unit's user interfaces and the installation of the DCU.

Chapter 3, Installation and operation of the Data Communications Module for the Series Three PC, describes the operation of the Data Communication Module's user interfaces and the installation of the DCM.

Chapter 4, Electrical Interface Circuits, provides the information needed to construct cables to connect the DCU or DCM to other devices.

Chapter 5, Communications Examples, explains how to build the Series Six ladder diagram to initiate communications between a Series Six or Series Six Plus PC and a Series One, Series One Plus, Series One Junior, or Series Three PC.

Chapter 6, Serial Interface Protocol, provides complete reference information on DCU and DCM serial interface protocol and timing to allow the user to write a serial communications driver for a host computer or microprocessor.

GEK-90507 Remote I/O User's Manual

This manual provides information needed to implement a Remote I/O system using the I/O of Series One and Series Three PCs.

Chapter 1, Introduction to Remote I/O, is a general description of the capabilities of Series One and Series Three PCs.

Chapter 2, Installation and wiring of the I/O Link modules, discusses the hardware used, installation, wiring, and fault detection.

Chapter 3, Configuring a Remote I/O system for the Series One PC, describes how to design and implement a Series One Remote I/O system.

Chapter 4, Configuring a Remote I/O system for the Series Three PC, describes how to design and implement a Series Three Remote I/O system.

Chapter 5, Configuring Mixed Remote I/O systems,describes how to design and implement a mixed (Series One and Series Three) Remote I/O system.

Chapter 6, Timing Considerations, explains how to determine the timing delays in the Remote I/O structure.

Appendix A, Power Supply Loading, lists the power characteristics of the power supplies and modules used in Series One and Series Three PCs.

Appendix B, Design Worksheets, contains handy worksheets for designing Remote I/O systems.

GEK-90825 Series Six PC I/O Link Local Module User's Manual

This manual describes the link between the Series Six family of programmable controllers and the I/O structure for the Series One and Series Three programmable controllers. This link is established between the Series Six I/O Link Local module and the Series One family and Series Three I/O Link Remote modules.

Chapter 1, Connecting the Series Six PC to the Series One or Series Three I/O system, is an overview of the system configuration and operation.

Chapter 2, Series Six PC I/O Link Local Module and Programming, explains how to install and operate the Series Six I/O Link Local module and how to program the Series Six CPU for I/O Link Local operations.

Chapter 3, Series One PC I/O Link Remote Module,explains the installation and operation of the Series One PC I/O Link Remote module.

Chapter 4, Series Three PC I/O Link Remote Module,explains the installation and operation of the Series Three PC I/O Link Remote module.

Chapter 5, Cable Wiring, describes cable wiring between the Series Six PC I/O Link Local module and the Series One or Series Three PC I/O Link Remote module.

Appendices A, B, and C, provide application information on setting up an example I/O chain and using the I/O chain status byte.

GEK-90846Portable Programmer User's Manual

The purpose of this manual is to provide information on the functions and features of the Portable Programmer and to instruct the user in installing, programming, and implementing the Portable

Programmer with the Series One programmable controller family and the Series Three programmable controller.

This manual contains nine chapters and six appendices. Each chapter contains sections to aid the user in locating required information.

Chapter 1, Product Summary, presents a product overview and describes the operating modes.

Chapter 2, Operation, explains the installation and operation of the portable Programmer.

Chapter 3, Introduction to Programming, provides general information on programming.

Chapter 4, Definition and Entry of Instructions, explains how to start a new program and contains the instruction sets.

Chapter 5, Edit Program, provides instructions for entering the Edit mode and editing functions.

Chapter 6, Display Program, provides the user with the information for displaying a ladder logic program.

Chapter 7, On-Line Monitor/Change, covers the On-Line Monitor and On-Line Change functions available for the Series One Plus and Series Three PCs.

Chapter 8, Communications, explains how programs may be stored on cassette tapes or transferred to the PCs.

Chapter 9, Print, covers the print options and functions.

Appendix A, Series One PC Serial Interface Setup, covers the Data Communications Unit and the CPU serial cable.

Appendix B, Series Three PC Serial Interface Setup, contains information needed for connecting a Series Three PC with the Portable Programmer.

Appendix C, Port Definition, describes the CPU serial port and the printer port.

Appendix D, Compatible Printers, contains the necessary information to implement and specifications for selection of compatible printers.

Appendix E, Series One Plus PC Password, contains instructions for password operation.

Appendix F, Portable Programmer Case, illustrates optional carrying case for the Portable Programmer.

GEK-96662 Logicmaster 1 Programmer Documentor Manual

This manual presents the information necessary to use the Workmaster industrial computer with the Logicmaster 1 application software to program a Series One PC. The information contained in this manual corresponds to version 02.01 of the Logicmaster 1 Programming and Documentation Software.

Chapter 1, Introduction, introduces the capabilities of the Logicmaster 1 software and also explains how to load and copy it.

Chapter 2, Workmaster Operation Using Logicmaster 1 Software, explains basic operation of the Workmaster industrial computer when using Logicmaster 1 software. Sections are included on the keyboard, display format, and keyswitch positions for the Workmaster computer and Series One PC.

Chapter 3, Programming the Series One PC, explains how to enter programming logic for the Series One PC through the Edit Program function.

Chapter 4, Advanced Programming Functions, explains how to annotate Series One programs and how to use the Teach function to make programming on the Workmaster computer easier.

Chapter 5, Logicmaster 1 System Functions, explains how to use the scratch pad, print programs, upload and download programs, and use the filing programs.

Appendix A, Menu Tree for Logicmaster 1 Software, provides a map to the function keys throughout the Logicmaster 1 software.

Appendix B, Port Characteristics and Wiring Diagrams, provides the information needed to connect the Workmaster computer to the Series One PC or peripherals such as an external disk drive or printer.

GFK-0075 Logicmaster 1 Family Programming and Documentation Software User's Manual

This manual provides the information necessary to use the Workmaster® and Cimstar I™ industrial computers with Logicmaster 1 Family application software to program the Series One Model E, Series One Plus, and Series One Plus 3.7K Programmable Controllers. The content of this manual is arranged similarly to GEK-96662, as described above.

Appendix B
Glossary of Terms

Address - A series of numbers from 0 to 1723 in the Series One and Series One Plus Programmable Controllers, assigned to specific program memory locations and used to access those locations.

AND - (Logical) A mathematical operation between bits, whereby all bits must be a 1 in order for the result to be a 1.

AND - (Function) An operation that places two contacts or groups of contacts in series. Both control the resultant status.

BCD (Binary Coded Decimal) - A 4-bit system in which individual decimal digits (0 through 9) are represented by 4-bit binary numerals; for example, the number 43 is represented by 0100(4) 0011(3) in the BCD notation.

Bit - The smallest unit of memory. Can be used to store only one piece of information having more than one state (for example, a one/zero, ON/OFF, good/bad, yes/no, etc). Data that requires more than two states (e.g. numerical values 000-999) will require multiple bits.

Byte - A measurement of memory, in the Series One and Series One Plus, equal to 8 bits.

CMOS - Acronym for Complimentary Metal-Oxide Semiconductor. A read/write memory that requires a battery to retain its content upon loss of power.

CPU (Central Processing Unit) - The central device or controller that interprets user instructions, makes decisions and executes the functions based on a stored program. This program specifies actions to be taken to all possible inputs.

Counter - A function within the PC that records events based upon the on/off transition of a signal. A coil associated with the counter is energized at a user determined preset value.

Field Devices - User supplied devices typically providing information to the PC (Inputs: pushbutton, limitswitches, relay contacts, etc.) or performing PC tasks (Outputs: motor starters, solenoids, indicator lights, etc.).

Group - A series of eight consecutive references, such as I/O points, internal coils, etc.

Inputs - A signal, typically ON or OFF, that provides information to the PC.

Instruction - A word, usually an acronym, or group of words and numerals that are part of a program entered into user memory.

I/O (Input/Output) - That portion of the PC to which field devices are connected. Isolates the CPU from electrical noise.

I/O Scan - A method by which the CPU monitors all inputs and controls all outputs within a prescribed time.

K - An abbreviation for kilo or exactly 1024 in the world of computers. Usually related to 1024 words of memory.

Ladder Diagram - A representation of control logic relay systems. The user programmed logic is expressed in relay equivalent symbology.

Latch - A PC operation that causes a coil to stay on and remain on even if power or the input is removed. Referred to as a retentive function.

Logic - A fixed set of responses (outputs) to various external conditions (inputs). All possible situations for both synchronous and non-synchronous activity must be specified by the user. Also referred to as the program.

Memory - a physical place to store information such as programs and/or data.

Microsecond (ms) - One millionth of a second. 1 x 10,-6 or 0.000001 second.

Millisecond (ms) - One thousandth of a second. 1 x 10,-3 or 0.001 second.

Modules - A replaceable electronic subassembly usually plugged in and secured in place but easily removable in case of fault or system redesign.

Noise - Undesirable electrical disturbances to normal signals generally of high frequency content.

Non-Retentive Coil - A coil that will turn off when power is removed.

Optical Isolation - Use of a solid state device to isolate the user input and output devices from internal circuitry of an I/O module and the CPU.

OR - (Logical) A mathematical operation between bits, whereby if any bit is a 1, the result will be a 1.

OR - (Function) An operation that places two contacts or groups of contacts in parallel. Either controls the resultant status.

Outputs - A signal typically ON or OFF, originating from the PC with user supplied power that controls external devices based upon commands from the CPU.

PC or PLC - See Programmable Controller.

Peripheral Equipment - External units that can communicate with a PC; for example, cassette tape recorder, Printer Interface Unit or PROM Writer Unit.

Preset - A numerical value specified in a function which establishes a limit for a counter or timer. A coil will energize when this value is reached.

Program - A sequence of functions and/or instructions entered into a Programmable Controller to be executed by the CPU for the purpose of controlling a machine or process.

Programmable Controller - A solid-state industrial control device which receives inputs from user supplied control devices such as switches and sensors, implements them in a precise pattern determined by ladder diagram based programs stored in the user memory, and provides outputs for control of user supplied devices such as relays and motor starters.

Programmer - A device for entry, examination and alteration of the PC's memory including logic and storage areas.

PROM - Acronym for Programmable Read Only Memory. A type of memory that requires a special method of loading, but is retentive upon power loss.

RAM - An acronym for Random Access Memory. A solid-state memory that allows individual bits to be stored and accessed. This type of memory is volatile; that is, stored data is lost under no power conditions, therefore a battery backup is required.

Read - To have data entered into a PC from a peripheral unit.

Reference - A number used in a program that tells the CPU where data is coming from or where to transfer the data.

Register - A group of consecutive memory locations within a PC, used for storage of numerical data.

Retentive Coil - A coil that will remain in its last state, even though power has been removed.

Rung - A sequence or grouping of PC functions and instructions that control one coil. One or more rungs form a ladder diagram.

Scan - The technique of examining or solving all logic steps specified by the program in a sequential, repetitive order from the first step to the last.

Thumbwheel Switch - A rotating numeric switch which can be used for inputting numeric data to a PC.

Unlatch - A PC function that causes an output previously turned on by a latch function to turn off no matter how briefly the function is enabled.

Word - A measurement of memory, in the Series One and Series One Plus, equal to 16 bits.

Write - To output or transfer data from the PC to a peripheral unit.

Appendix C
Series One Family of Programmable Controllers Compatibility Guide

Feature	Junior	One™	Model E	Plus	Plus 3.7K
I/O Points (maximum)	24 Basic Unit 50 W/Exp Unit 96 W/Exp Rack	112	112	168	168
Memory					
Memory, 700 words CMOS RAM	standard	standard	standard	standard	n/a
Memory, Expand to 1724 words	no	yes (1)	yes (1)	yes (1)	n/a
Memory, 3700 words CMOS	no	no	no	no	yes
RAM					
EPROM, non-volatile storage	yes (2)	yes (2)	yes (2)	yes (2)	yes (2)
Battery Back-Up	yes	yes	yes	yes	yes
Typical Scan 0.5 K Program:	20 mSec	20 mSec	8 mSec	8 mSec	8 mSec
Times1.0 K Program:	40 mSec	40 mSec	12 mSec	12 mSec	12 mSec
1.7 K Program:	n/a	65 mSec	15 mSec	15 mSec	15 mSec
3.7 K Program:	n/a	n/a	n/a	n/a	36 mSec
Internal Functions	160	144	144	144	144
Non-Retentive Coils	96	112	112	112	112
Retentive Coils	59	28	28	28	28
Special Function Coils	5	4	4	4	4
Timers/Counters	20 (4-digit)	64 (4-digit)	64 (4-digit)	64 (4-digit)	64 (4-digit)
Thumbwheel Interface Module	no	yes	yes (3)	yes (3)	yes (3)
Timer/Counter Setpoint Unit	yes	no	yes (3)	yes (3)	yes (3)
Shift Registers	155 steps	128steps	128 steps	128 steps	128 steps
Data Registers (12)	no	no	no	64 (16-bit)	64 (16-bit)
Sequencers	20 (1000 step)	64 (1000 step)	64 (1000 step)	64 (1000 step)	64 (1000 step)
High Speed Counter					
Built-In (2 KHz)	yes	no	no	no	no
I/O Module (10 KHz)	no	yes	yes	yes	yes
Discrete I/O Modules	yes (4, 5, 6)	yes	yes	yes	yes
Analog I/O Modules	yes (4, 7)	yes (7)	yes (7)	yes	yes
UL Listed Modules	yes	yes	yes	yes	yes
Remote I/O	yes (9)	yes (8)	yes (8)	yes (8)	yes (8)
No. of I/O in Remote System	26, 40 or 72	96	96	96	96
Programming Language					
Basic Ladder Diag. Functions	yes	yes	yes	yes	yes
Data Operations and Math	no	no	no	yes	yes
Program W/Hand-Held Programmer					
IC610PRG100	yes	yes	yes	yes (11)	yes (11)
IC610PRG105	yes	yes	yes	yes	yes
Hand-Held Prog Mount Assembly	yes	yes	yes	yes	yes

1. CMOS RAM memory
   Series One, 6116LP, Series One Plus, 6264LP-15 (low power devices only)
2. EPROM memory
   Series One Junior & Series One, 2732
   Series One Plus, 27256-25
   Series One Plus 3.7K, 27256-25
3. One Thumbwheel Interface or one Timer/Counter Setpoint Unit can be used in a system, not both
4. Requires Series One 5 or 10-slot expansion rack.
5. Limited to one 16-point module per system.
6. See I/O Module Compatibility Chart
7. Has limited usefulness
8. Remote I/O stations can be located up to 3300' (1Km) from the CPU, connected by twisted-pair cable to I/O Link Local and I/O Link Remote modules.
9. Expansion rack can be 100' (30m) from basic unit, connected through an I/O Expansion cable to a basic unit and an I/O Expansion module in the Expansion rack.
10. Applies to Series One Junior only.
11. PRG 100 cannot access data registers, data operations, or math.
12. Up to 124 total if unused Timer/Counter references used as data registers.

Feature	Junior	One™	Model E	Plus	Plus 3.7K
Program with Workmaster® Computer or IBM Personal Computer	(1)	yes	yes	yes	yes
Program with LCD Port. Programmer	yes	yes	yes	yes	yes
CPU					
IC610CPU101 (UL Listed)	n/a	yes	no	no	no
IC610CPU104	n/a	no	yes	no	no
IC610CPU105	n/a	no	no	yes	no
IC610CPU106	n/a	no	no	no	yes
Password Protection Available	no	no	yes	yes	yes
Racks					
5-slot, IC610CHS101 (2)(6)	no	yes	yes	yes	yes
5-slot, IC610CHS110 (2)	yes(expansion)	yes	yes	yes	yes
5-slot, IC610CHS111 (5)	yes(expansion)	yes	yes	yes	yes
5-slot, IC610CHS114 (3)	yes(expansion)	yes	yes	yes	yes
10-slot, IC610CHS130 (2)	yes(expansion)	yes	yes	yes	yes
10-slot, IC610CHS134 (3)	yes(expansion)	yes	yes	yes	yes
19" Rack Mounting Brackets	yes (4)	yes (4)	yes (4)	yes (4)	yes (4)
Data Communications Unit, CCM100	yes	yes	no	no	no
Data Communications Unit, CCM105	yes	yes	yes	yes	yes Rev C
RS-232/422 Adaptor Unit	yes	yes	yes	yes	yes
Peripheral Devices					
Printer Interface Unit	yes Rev A & B	yes Rev A & B	yes Rev B	yes Rev B	yes
Rev C					
PROM Writer Unit	yes Rev A & B	yes Rev A & B	yes Rev B	yes Rev B	yes Rev C
Timer/Counter Setpoint Unit	yes	no	yes	yes	yes
Cassette Tape Recorder	yes	yes	yes	yes	yes
Accessory Kit	included	yes	yes	yes	yes

1. Future enhancement with this product.
2. Requires 115/230 V ac power source.
3. Requires 24 V dc power source.
4. Used with 10-slot rack.
5. UL Listed, 115 V ac power source only.
6. Not expandable

GENERAL SPECIFICATIONS

Humidity	5% to 95% (non-condensing)
Typical Battery Life	
Operating	2 to 5 Years
Shelf Life	8 to 10 Years
Operating Power For	115/230 V ac
Series One Junior Basic	24 V dc
Units and all Racks	See specifications for each unit or rack for details

Table C-1. I/O Module Capability/Compatibility Guide

Feature	Junior	One™	Model E	Plus	Plus 3.7K
Input Modules					
IC610MDL125 115 V ac, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL127 230 V ac, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL126 115 V ac Isolated, 4 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL101 24 V dc Sink, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL107 24 V dc Sink Load, 16 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL106 24 V dc Sink, 16 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL111 24 V ac/dc Source, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL112 24 V ac/dc Source, 16 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL116 Analog Inputyes (1)	yes	yes	yes	yes	
IC610MDL135 (UL Listed) 115 V ac Input, 6 Circuits	yes (1)	yes	yes	yes	yes
Output Modules					
IC610MDL175 115/230 V ac, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL176 115/230 V ac Isolated, 4 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL151 24 V dc Sink, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL156 24 V dc Sink, 16 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL153 24 V dc 2 A Sink, 4 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL154 24 V dc 2 A Sink/Source, 4 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL155 24 V dc Source, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL158 24 V dc Source, 16 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL166 Analog Output	yes (1)	yes	yes	yes	yes
IC610MDL180 Relay Output, 8 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL181 (UL Listed) Relay Output, 5 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL182 Relay Output, 16 Circuits	yes (1)	yes	yes	yes	yes
IC610MDL185 (UL Listed) Relay Output, 8 Circuits	yes (1)	yes	yes	yes	yes
Special Modules					
IC610MDL103 24 V dc In/Out, 4 In/4 Out	yes (1)	yes	yes	yes	yes
IC610MDL104 24 V dc Sink In/Rly Out, 4 In/4 Out	yes (1)	yes	yes	yes	yes
IC610MDL115 Fast Response I/O, 4 In/2 Out	yes (1)	yes	yes	yes	yes
IC610MDL124 I/O Simulator, 8 Input Circuits	yes (1)	yes	yes	yes	yes
IC609TCU100 Timer/Counter Setpoint Unit	yes (1)	no	yes (2)	yes (2)	yes (2)
IC610MDL105 Thumbwheel Interface	no	yes	yes (2)	yes (2)	yes (2)
IC610MDL110 High Speed Counter	no	yes	yes	yes	yes

1. Requires a 5 or 10-slot expansion rack.
2. One Thumbwheel Interface or one Timer/Counter Setpoint unit can be used in a Series One Plus system, not both.

Table C-2. Summary of Programming References for Series One Family of Programmable Controllers

Memory Type	Valid References (Octal)	Decimal Quantity
Series One Junior		
I/O Points		96 total
Basic Unit Inputs	000-016	15
Basic Unit Outputs	017-027	9
I/O Expansion Unit Inputs	030-047	16
I/O Expansion Unit Outputs	058-061	10
Expansion Rack I/O	030-067 130-137	40
Internal Coils		160 total
Non-Retentive	140-277	96
Retentive	300-372	59
Set Retentive Coils	373	1
First Scan Reset	374	1
0.1 Second Clock	375	1
Disable All Outputs	376	1
Back-Up Battery Status	377	1
Shift Register	140-372	155 (total steps)
Timers and Counters	600-623	20 (4 digit) (1)
High Speed Counter	624	1
Sequencers	600-623	20 (1000 step)
Series One/Series One Model E		
I/O points	000-157	112 total
Internal Coils		144 total
Non-Retentive	160-337	112
Retentive Coils	340-373	28
Initial Reset	374	1
0.1 Second Clock	375	1
Disable All Outputs	376	1
Back-Up Battery Status	377	1
Shift Registers	400-577	128 steps
Timer/Counters	600-677	64 (1)
Sequencers	600-677	64 (1000 steps)
Series One Plus/Series One Plus 3.7K		
I/O points000-157	168 total 700-767	
Internal Coils		144 total
Non-Retentive	160-337	112
Retentive Coils	340-373	28
Initial Reset	374	1
0.1 Second Clock	375	1
Disable All Outputs	376	1
Back-Up Battery Status	377	1
Special Purpose Coils	8	
Shift Registers	400-577 (2)	128 steps
Timer/Counters	600-677	64 (1)
Sequencers	600-677	64 (1000 steps)
Data Registers	400-577 (2)	64 (16-bit)

1. Total maximum number of Timers and/or Counters.
2. Although shift registers and data register references are the same, shift registers operate on individual bits, while data registers operate on bytes in a totally different are of memory.
3. Unused T/C references can be used as data registers which provides up to 124 16-bit data registers (T/C references 674-677 are reserved for T/C use only).

Table C-3. Programming Function Compatibility Guide

Feature	Junior	One™	Model E	Plus	Plus 3.7K
Basic Ladder Diagram Functions					
STR, STR NOT	yes	yes	yes	yes	yes
AND, AND NOT	yes	yes	yes	yes	yes
OR, OR NOT	yes	yes	yes	yes	yes
SET, RST	yes	yes	yes	yes	yes
OUT	yes	yes	yes	yes	yes
SET OUT	yes	yes	yes	yes	yes
SET OUT RST	no	no	no	yes	yes
OR STR	yes	yes	yes	yes	yes
MCS, MCR	yes	yes	yes	yes	yes
TMR	yes	yes	yes	yes	yes
STR TMR	yes	yes	yes	yes	yes
STR NOT TMR	yes	yes	yes	yes	yes
AND TMR	yes	yes	yes	yes	yes
AND NOT TMR	yes	yes	yes	yes	yes
OR TMR	yes	yes	yes	yes	yes
OR NOT TRM	yes	yes	yes	yes	yes
CNT	yes	yes	yes	yes	yes
STR CNT	yes	yes	yes	yes	yes
STR NOT CNT	yes	yes	yes	yes	yes
AND CNT	yes	yes	yes	yes	yes
AND NOT CNT	yes	yes	yes	yes	yes
OR CNT	yes	yes	yes	yes	yes
OR NOT CNT	yes	yes	yes	yes	yes
SR	yes	yes	yes	yes	yes
Data Operations					
D•STR (Data Store)	no	no	no	yes	yes
D•STR1	no	no	no	yes	yes
D•STR2	no	no	no	yes	yes
D•STR3	no	no	no	yes	yes
D•STR5	no	no	no	yes	yes
D•OUT (Data Out)	no	no	no	yes	yes
D•OUT1	no	no	no	yes	yes
D•OUT2	no	no	no	yes	yes
D•OUT3	no	no	no	yes	yes
D•OUT5	no	no	no	yes	yes
COMPARE	no	no	no	yes	yes
ADD	no	no	no	yes	yes
SUBTRACT	no	no	no	yes	yes
MULTIPLY	no	no	no	yes	yes
DIVIDE	no	no	no	yes	yes
D•AND (Logical AND)	no	no	no	yes	yes
D•OR (Logical OR)	no	no	no	yes	yes
INVERT	no	no	no	yes	yes
BIN (BCD To Binary Convert)	no	no	no	yes	yes
BCD (Binary To BCD Convert)	no	no	no	yes	yes
SHIFT RIGHT	no	no	no	yes	yes
SHIFT LEFT	no	no	no	yes	yes
DECODE	no	no	no	yes	yes
ENCODE	no	no	no	yes	yes
EXTERNAL FAULT DIAGNOSIS	no	no	no	yes	yes

Table C-4. Examples of Valid System Configurations for I/O Points

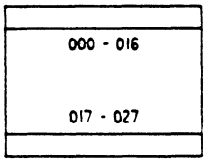
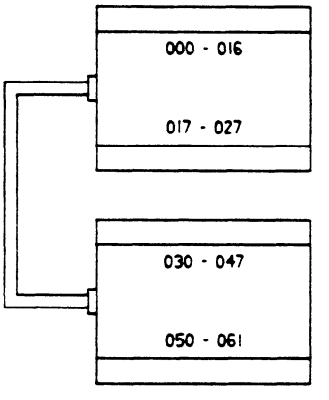
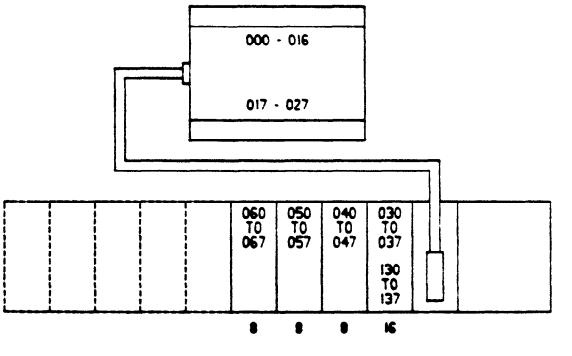
I/O Points	PC and Rack Type	I/O Module Type	Valid Configuration and References
24	Series One Junior IC609SJR100 IC609SJR102 IC609SJR110 IC609SJR114 IC609SJR120 IC609SJR124 IC609SJR121	Basic Unit Inputs - 15 Outputs - 9	TPK.A.40896 
50	Series One Junior IC609SJR100 IC609SJR102 IC609SJR110 IC609SJR114 IC609SJR120 IC609SJR124 IC609SJR121 I/O Expansion Units IC609EXP110 IC609EXP120 IC609EXP121	Basic Unit Inputs - 15 Outputs - 9 I/O Expansion Inputs - 16 Outputs - 10	TPK.A.41931 
64	Series One Junior IC609SJR100,102 IC609SJR110, 114 IC609SJR120, 124 IC609SJR121 And One Expansion Rack 5 or 10-Slot Rack IC610CHS110, 114 IC610CHS130, 134 IC610CHS120, 124	Basic Unit Inputs - 15 Outputs - 9 24 I/O (3) 8-Point (1) 16-Point 40 I/O	TPK.A.40897 

Table C-4. Examples of Valid System Configurations for I/O Points - Continued

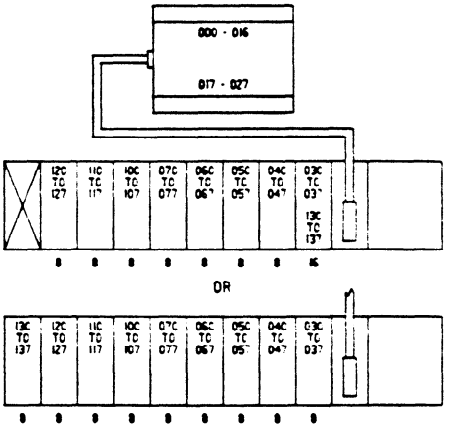
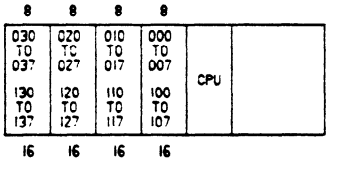
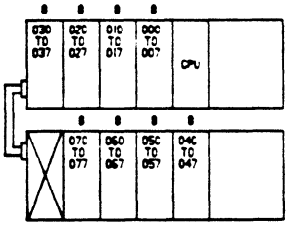
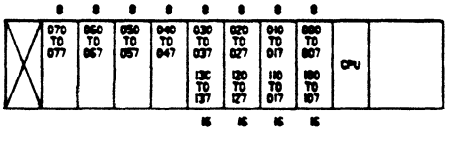
I/O Points	PC and Rack Type	I/O Module Type	Valid Configuration and References
96	Series One Junior IC609SJR100, 102 IC609SJR110, 114 IC609SJR120, 124 IC609SJR121 And One Expansion Rack 10-Slot Rack IC610CHS130, 134 IC610CHS120, 124	Basic Unit Inputs - 15 Outputs - 9 24 I/O 72 I/O (7) 8-Point (1) 16-Point or (9) 8-Point	TPK.A.41932 
32 64	Series One Series One Model E Series One Plus Series One Plus 3.7K (1) 5-Slot Rack IC610CHS110 IC610CHS114 IC610CHS101	(4) 8-Point Modules or (4) 16-Point Modules	TPK.A.40898 
64	Series One Series One Model E Series One Plus Series One Plus 3.7K (2) 5-Slot Racks IC610CHS110 IC610CHS114	(8) 8-Point Modules	TPK.A.41933 
64	Series One Series One Model E Series One Plus Series One Plus 3.7K (1) 10-Slot Rack IC610CHS130 IC610CHS134 IC610CHS120 IC610CHS124	(8) 8-Point or (4) 16-Point	TPK.A.41934 

Table C-4. Examples of Valid System Configurations for I/O Points - Continued

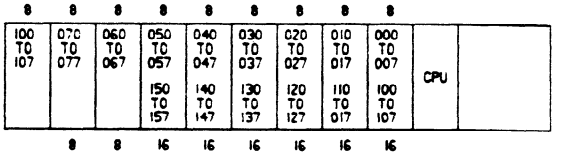
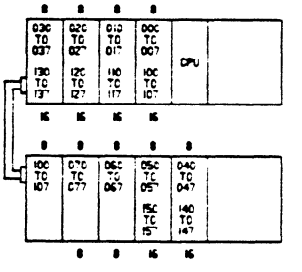
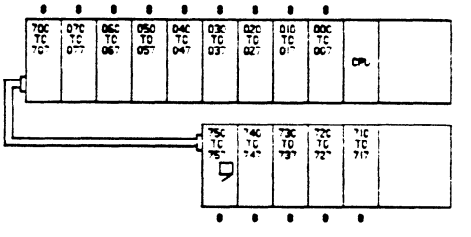
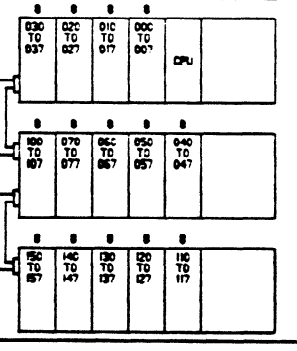
I/O Points	PC and Rack Type	I/O Module Type	Valid Configuration and References
72	(9) 8-Point Series One Series One Model E Series One Plus	Modules or	TPK_A.40920 
112	Series One Plus 3.7K (1) 10-Slot Rack IC610CHS130 IC610CHS134 IC610CHS120 IC610CHS124	(2) 8-Point Modules (6) 16-Point Modules	*Not used with 112 I/O Configuration
72	(9) 8-Point Series One Series One Model E Series One Plus	Modules or	TPK_A.40899 
112	Series One Plus 3.7K (2) 5-Slot Rack IC610CHS110 IC610CHS114	(2) 8-Point Modules (6) 16-Point Modules	
112	Series One Plus 3.7K Series One Plus (1) 10-Slot Rack IC610CHS130, 134 And (1) 5-Slot Rack IC610CHS110, 114	(14) 8-Point Modules	TPK_A.40922 
112	Series One Series One Model E Series One Plus Series One Plus 3.7K (3) 5-Slot Racks IC610CHS110 IC610CHS114	(14) 8-Point Modules	TPK_A.40923 

Table C-4. Examples of Valid System Configurations for I/O Points - Continued

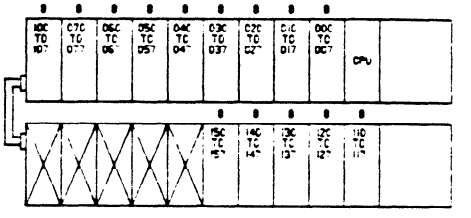
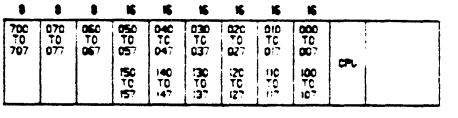
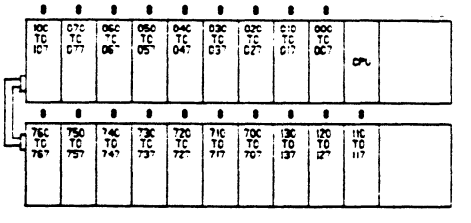
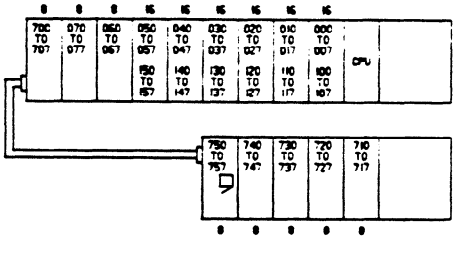
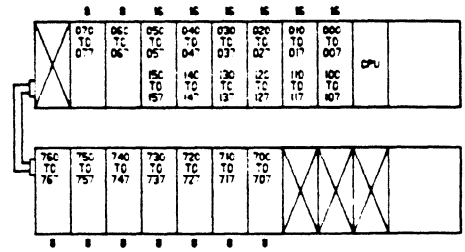
I/O Points	PC and Rack Type	I/O Module Type	Valid Configuration and References
112	Series One Series One Model E (2) 10-Slot Racks IC610CHS130 IC610CHS134 IC610CHS120 IC610CHS124	(14) 8-Point Modules	TPK_A.41935 
120	Series One Plus Series One Plus 3.7K IC610CHS130 IC610CHS134	(6) 16-Point Modules And (3) 8-Point Modules	TPK_A.40924 
152	Series One Plus Series One Plus 3.7K (19) 8-Point IC610CHS130 IC610CHS134	Modules	TPK_A.41936 
160	Series One Plus Series One Plus 3.7K (1) 10-Slot Rack IC610CHS130, 134 And (1) 5-Slot Rack IC610CHS110, 114	(8) 8-Point Modules (6) 16-Point Modules	TPK_A.40925 

Table C-4. Examples of Valid System Configurations for I/O Points - Continued

I/O Points	PC and Rack Type	I/O Module Type	Valid Configuration and References
168	Series One Plus Series One Plus 3.7K (2) 10-Slot Racks IC610CHS130 IC610CHS134	(9) 8-Point Modules (6) 16-Point Modules	TPK_A.40926 

1. These examples represent only a sampling of the many configurations of racks and I/O points that are available. Configurations depend on the number of I/O points and type of I/O modules (4, 8, or 16 points and the units of load used by the modules) required for a particular application.
2. If modules having only 4 I/O points are used in any slot, the references not used as "real world" I/O are available for use as internal references in the user program.
3. The 10-slot racks (IC610CHS130 and IC610CHS134) have 2 bridge connectors on the backplane which must be configured for proper rack addressing. Configuration of the bridge connectors is explained in chapter 3, Installation. The X in a slot means that there is no valid address for that slot for that configuration.

Appendix D
Other Programmable Controllers

Series One™ Junior Programmable Controller

The Series One Junior programmable controllers are a group of low cost controllers specifically designed for control applications requiring 4 to 60 relays. The Series One Junior offers a control package using only 53 square inches of mounting area, which is about the same as four 4-pole relays. Series One Junior PCs are available in various combinations of voltages.

Each Series One Junior basic unit has 24 built-in I/O circuits, including 15 inputs and 9 outputs. User memory is 700 words of CMOS-RAM, or optional EPROM memory. If more than 24 I/O points are required, expansion is accomplished by one of two methods, either add a Series One Junior I/O expansion unit or a 5 or 10 slot expansion rack to the basic unit. A system can have up to 50 I/O points by adding an I/O expansion unit, which has the same form as the basic unit.Up to 96 I/O points can be included in a system by adding a standard Series One 5 or 10-slot rack to the Series One Junior basic unit.

Any combination of standard Series One I/O modules can be included in an expansion rack, with the exception of the High Speed Counter module or the Thumbwheel Interface Unit. The expansion rack can be located up to 100 feet (30 m) from a Series One Junior.

The Series One Junior has a built-in high speed counter capable of counting pulses up to 2000 counts per second. The programming language is the same (basic ladder diagram functions) as is used to program the Series One and Series One Plus. Programs can be entered using either the hand-held programmer, which can be mounted on the basic unit, or the LCD Portable Programmer. Many programs developed on the Series One Junior PC can be transferred to a Series One or Series One Plus PC.

Table D-1. Series One Junior Capabilities

Number of I/O Points (Maximum)	96 total
Basic Unit Inputs	15
Basic Unit Outputs	9
Expansion Unit Inputs	16
Expansion Unit Outputs	10
Expansion Rack I/O (Mixed I/O)	72
Internal Coils	160 total
Non-Retentive	96
Retentive	59
Special Function	5
Shift Registers	128 steps
Timers/Counters	64 (1)
High Speed Counter, Built-In	1
Sequencers	64 (1000 steps)

(1) Maximum total number of Timers and Counters or a combination of Timers and Counters.
Optional devices include the Timer/Counter Setpoint Unit, Data Communications Unit, Printer Interface Unit, PROM Writer Unit, and an audio cassette tape recorder.

GEK-90842

Series Three™ Programmable Controller

The Series Three PC is a compact programmable controller capable of handling applications in the 16 to 400 I/O range. It offers many of the same outstanding features as the Series One family of programmable controllers such as compact size, CMOS or PROM memory, hand held programmer, and low price. Improved capabilities include 4K memory, 400 I/O points, and four function math. Following are specifications for the Series Three PC:

Table D-2. Series Three PC Specifications

Size for CPU and 128 I/O (W x H x D)	18.9" x 10.3" x 6.3 (480mm x 262mm x 159mm)
Functions	Relay including Latches Timers (1.0, 0.1 Sec) Counters Master Control Relay Shift Registers Add, Subtract, Compare Multiply, Divide Data Moves Subroutine
Scan Rate	20 msec. for 2K 40 msec. for 4K
Internal References	400 I/O 64 Latches 304 Internal Coils 128 Shift Register Stages 128 Timer/Counters (4 digit)
Programmer	Built-In with Keylock

Available I/O Types

INPUTS	I/O POINTS	OUTPUTS	I/O POINTS
115 V ac/dc	16	115/230 V ac (2 A)	16
Isolated 115 V ac	8	Isolated 115/230 V ac (2A)	8
24 V dc	16	24 V dc (2 amp)	8
24 V dc	32	24 V dc (1 Amp)	16
24 V ac/dc Source	16	24 V dc	32
230 V ac	16	Relay Out	16
Analog	2	Analog	2
5 - 12 V dc	32	5 - 12 V dc	32

OTHER MODULES

High Speed Counter, I/O Link Local and Remote (Twisted Pair and Fiber Optics), Data Communications, 24 V dc In/Out (16/16), I/O Simulator

Series Six™ Programmable Controller

The family of Series Six programmable controllers consists of three models: 60, 600, 6000. The capacity for memory and Input/Output increases as the model number increases. Each model also has internal register storage in varying sizes. The family concept allows the use of common features between models. The common features include a common programming language featuring a basic, extended, and advanced set, the same reference numbers, the same Workmaster industrial computer for programming and running many available programs tailored for industrial applications, the same I/O structure; including modules, racks and cables, most of the same CPU modules, transportable programs from one model or size to another (upward or downward compatibility) and the same options. Memory and I/O capability are listed in Table D.3.

Table D-3. Series Six CPU Capacities

MODEL	LOGIC MEMORY	I/O CAPACITY		REGISTER STORAGE
		INPUTS	OUTPUTS	
60	4K	1000	1000	1024
600	8K	1000	1000	8192
6000	32K	2000	2000	8192

Programming

Programs are entered using the LogicMaster 6 software package on the Workmaster® industrial computer. The Workmaster has a 9" CRT display, a full-travel keyboard, integral 3 1/2" diskette drive, and full off-line/stand along programming. Programming logic is basically a relay ladder diagram language consisting of relay ladder logic (N.O. and N.C. contacts, counters, timers, one-shots and latches). Additional features in the Basic group include Arithmetic (add, subtract, and compare), data moves, binary and BCD conversion, a Master Control Relay function and communication requests. The extended Mnemonic group includes the following functions:

- Data Moves (Left 8, Right 8, Block)
- Signed Arithmetic (Double Precision Add and Subtract, Extended Add and Subtract, Multiply, Divide and Greater Than)
- Table Moves (Table-To-Destination, Source-To-Table, Move Table and Move Table Extended)
- List (Add-To-Top, Remove-From-Bottom, Remove-From-Top and Sort)
- Matrix (AND, OR, Exclusive OR, Invert and Compare)
- Bit Matrix (Bit Set, Bit Clear, Shift Right, Shift Left)
- Control (Do Subroutine, Return, Suspend I/O, Do I/O and Status)

The advanced function adds an additional Table Move instruction, Move Table Ex, which has the ability to address all 8192 registers in an advanced model 600 or a model 6000.

I/O modules available for the Series Six PCs include the following:

- 115/230 V ac/dc, Inputs and Outputs
- 115/230 V ac Isolated Inputs and Outputs
- 12 V ac/dc Inputs
- 24-48 V ac/dc Inputs
- 12, 24, 48 V dc Sink and Source Outputs
- 120 V dc Outputs
- High Density Inputs (32 Inputs)
- High Density Outputs (32 Outputs)

- Reed Relay Outputs
- Analog Inputs and Outputs
- Thermocouple Inputs
- Interrupt Inputs
- Axis Positioning, Type 1 and Type 2
- High Speed Counter
- ASCII BASIC module, 12K or 20K versions
- I/O Receiver and Transmitter for operation up to 2000 feet (600 meters).
- Remote I/O Driver and Receiver for cable operation up to 10,000 feet (3 Km) or unlimited distance over a modem link.

Optional Items

Optional items for use with a Series Six PC include a Redundant Processor Unit (RPU), Communications Control Modules, an Operator Interface Unit (OIU), color and amber Operator Interface Terminals (OIT), ProLoop™process controllers, and various software packages for use with the Workmaster information center. The software packages include VuMaster™, FactoryMaster™, and ProcessMaster™. Additional software packages will be available in the future.

The RPU acts as a switch to transfer control from one Series Six CPU or I/O chain to a standby in the event that a failure occurs in the first. This provides a method of minimizing downtime in the event of a failure in the PC system.

The Type 2 Communications Control Module (CCM) provides 2 independent ports (RS-232C, RS-422, or 20 mA) for slave communications with computers or similar intelligent devices. The Type 2 CCM also has the added function of originating communications to other Series Six CPUs, computers, or other similar intelligent devices from the user's ladder diagram program. The Type 3 CCM also provides 2 ports, and the protocol required for interfacing to selected process control systems.

The OIU is a hand-held micro-terminal that allows an operator to monitor or modify the register contents and I/O states of a Series Six CPU. The OIU communicates with a CPU through the Communications Control module (Type 2).

The OIT connects to the Series Six through an ASCII/BASIC module and provides CRT background screens for the display of status from the CPU. User configuration of the screens allows tailoring the screens to fit the application.

The ProLoop process controllers are a group of analog controllers that can operate independent of, but be supervised by a Series Six PC.

Series Six™ Plus Programmable Controller

The Series Six Plus is a cost effective programmable controller that can be easily expanded to cover a wide variety of applications. The Series Six Plus offers in one rack, more capability than the Series Six family of programmable controllers, which includes models 60, 600 and 6000.

A Combined Memory module, which includes internal memory, up to 16K words of user memory and up to 16K of register memory, is available in six different configurations as shown below in Table D.4

Table D-4. Series Six Plus Combined Memory Configurations

Total Memory	User Memory	Register Memory
5K	4K	1K
12K	4K	8K
16K	8K	8K

Table D-4. Series Six Plus Combined Memory Configurations - Continued

Total Memory	User Memory	Register Memory
24K	16K	8K
48K	32K	16K
80K	64K	16K

The Series Six Plus PC can be configured to have up to 16K Inputs and 16K Outputs. Instruction sets for programming are available in 3 versions; Advanced, Expanded, and Expanded II. The expanded function set has all previous Series Six instructions plus several new instructions and enhancements which include:

Reference range expanded for 16K I/O
Floating Point functions, including:

- Add, subtract, multiply, divide, greater than
- Integer to floating point
- Floating point to integer

Enhanced DO I/O and STATUS instructions
New WINDOW function

The Series Six Plus PC also includes enhanced GENIUS I/O diagnostics and expanded error checking. The CPU rack, which contains all required CPU modules, has 6 slots available for I/O modules.

The Series Six Plus PC is compatible with all existing Series Six I/O modules, peripherals and software packages. Programs are entered with the Workmaster® industrial computer, as with the Series Six family of PCs.

1

10-Slot Rack, 2-3
115 V ac Input Module, IC610MDL129, 6-76
115 V ac Input Module, UL Listed IC610MDL135, 6-73
115 V ac Input, IC610MDL125, 6-7
115 V ac Isolated Input, IC610MDL126, 6-9
115 V ac Output Module, UL Listed IC610MDL185, 6-75
115/230 V ac Isolated Output IC610MDL176, 6-17
115/230 V ac Output IC610MDL175, 6-16
16 Circuit I/O Modules with Connectors, 6-4

2

230 V ac Input, IC610MDL127, 6-8
24 V ac Sink Output (16 Circuits) IC610MDL156, 6-19
24 V ac Sink Output (8 Circuits) IC610MDL151, 6-18
24 V ac/dc Source Input (16 Circuits), IC610MDL112, 6-14
24 V ac/dc Source Input, IC610MDL111, 6-13
24 V dc 2 Amp Sink Output IC610MDL153, 6-22
24 V dc 2 Amp Sink/Source Output IC610MDL154, 6-23
24 V dc Input/Output (4 In/4 Out) IC610MDL103, 6-31
24 V dc Input/Output (4 In/4 Out) IC610MDL104, 6-33
24 V dc Sink Input (16 Circuits), IC610MDL106, 6-11
24 V dc Sink Input (8 Circuits), IC610MDL101, 6-10
24 V dc Sink Load Input (16 Circuits), IC610MDL107, 6-12
24 V dc Sink Output (16 Circuits) IC610MDL157, 6-20
24 V dc Source Output (16 Circuits) IC610MDL158, 6-26
24 V dc Source Output IC610MDL155, 6-24

5

5-Slot Rack, 2-3
5-Slot Rack, UL Listed IC610CHS111, 6-72

A

Accessory Kit, IC610ACC120, 7-6
Adding Memory, 7-5
Adding Racks, 2-2
Advantages and Features, 1-2
Advantages Over Other Control Devices, 1-1
Alter One Logic Element, 4-11
Analog Input IC610MDL116, 6-62
Analog Output IC610MDL166, 6-67
Appendix A - Related Documentation, A-1
Appendix B - Glossary of Terms, B-1
Appendix C - Compatibility Guide, C-1
Appendix D - Other Programmable Controllers, D-1
Applications, 8-1
  Application 1 - One-Shots, 8-1
  Application 2 - Flip Flop, 8-2
  Application 3 - Event/Time Drum, 8-3
  Application 4 - Cascaded Counters, 8-5
  Application 5 - Coil 374, Power-Up One-Shot, 8-7
  Application 6 - Coil 375, 10Hz Clock, 8-8
  Application 7 - Start/Stop Circuit, 8-11
  Application 8 - High Speed Counter, 8-12
  Application 9 - Typical Shift Registers, 8-21

B

Basic Instructions, 5-19
Basic Ladder Diagram Instructions, 5-1
Basic PC Block Diagram, 1-5
Basic Troubleshooting, 7-1
Bridge Connectors, 10-Slot Rack, 3-5

C

Catalog Numbers, 5

Central Processing Unit, Function of, 1-6
Change Contents of a Data Register, 4-14
Clear All Memory, 4-12
Components, Replacement of, 7-3
CPU Option Settings, 3-8
CPU Programmer Cable, 2-4
CPU Scanning Sequence, 5-15

D

Data Communications, 1-3
Data Communications Unit, 1-8, 2-10
Data Operation Block Diagram, 5-43
Data Operation Instructions, 5-4, 5-43
Data Registers, 5-13
DCU, 2-10
Delete One Logic Element, 4-12
Display a Specific Address, 4-13

E

Earth Ground Wire, 3-10
Enter or Change a Password, 4-14
  LOG IN, 4-14
  LOG OUT, 4-15
Entering Basic Instructions, 5-24
  AND STR, OR STR, 5-24
  Basic Relay Logic, 5-20
  Disabling of Outputs, 5-29
  Latched Relay, 5-26
  Master Control Relay, 5-27
  Normally Closed Input, 5-22
  Push-Down Stack, 5-23
  Retentive Coils as Latches, 5-26
  Rung with Parallel Contacts, 5-20
  Rung with Series Contacts, 5-19
  Simple Timer Rung, 5-20
Error Code Definitions, 4-7
Error Codes, 4-7
Example of Counters, 5-33
Example of Relay Control, 2-9
Example of Timer Logic, 5-31
Expanded Cable Installation, 2-4

F

Fast Response I/O IC610MDL115, 6-56
Faster Scan Rate, 1-3
Field Wiring to I/O Modules, 6-2
Forcing I/O References, 5-42
Forcing References, 4-15
Fuse List, 7-7

G

General Specifications, 1-3
General Troubleshooting, 7-2
Ground, Earth, 3-10
Grounding, Rack, 3-3

H

Hand-Held Programmer, 1-1, 1-5
Hardware Requirements, 2-7
Heat Dissipation, 2-2
High Density Module with Removable Connector, 6-3
High Speed Counter IC610MDL110, 6-39
History of Programmable Controllers, 1-1

I

I/O Addressing Switches, 3-6
I/O Expansion Cable Connection, 3-4
I/O Interface Cable Cross Reference List, 6-5
I/O Interface Cable Wiring List, 6-4
I/O Module Capability/Compatibility Guide, C-3
I/O Module Catalog Numbers, 6-6
I/O References for 16 Circuit Modules, 6-4
I/O Simulator IC610MDL124, 6-61
I/O Specifications and Wiring, 6-1
IC610CHS111, 5-Slot Rack, UL Listed, 6-72
IC610MDL101, 24 V dc Sink Input (8 Circuits), 6-10
IC610MDL103, 24 V dc Input/Output (4 In/4 Out), 6-31

IC610MDL104, 24 V dc Input/Output (4 In/4/Out), 6-33
IC610MDL105, Thumbwheel Interface, 6-36
IC610MDL106, 24 V dc Sink Input (16 Circuits), 6-11
IC610MDL107, 24 V dc Sink Load Input (16 Circuits), 6-12
IC610MDL110, High Speed Counter, 6-39
IC610MDL111, 24 V ac/dc Source Input, 6-13
IC610MDL112, 24 V ac/dc Source Input, 6-14
IC610MDL115, Fash Response I/O, 6-56
IC610MDL116, Analog Input, 6-62
IC610MDL124, I/O Simulator, 6-61
IC610MDL125, 115 V ac Input, 6-7
IC610MDL126, 115 V ac Isolated Input, 6-9
IC610MDL127, 230 V ac Input, 6-8
IC610MDL129, 115 V ac Input Module, 6-76
IC610MDL135, 115 V ac Input Module, UL Listed, 6-73
IC610MDL151, 24 V ac Sink Output (8 Circuits), 6-18
IC610MDL153, 24 V dc 2 Amp Sink Output, 6-22
IC610MDL154, 24 V dc 2 Amp Sink/Source Output, 6-23
IC610MDL155, 24 V dc Source Output, 6-24
IC610MDL156 24 V ac Sink Output (16 Circuits), 6-19
IC610MDL157 24 V dc Sink Output (16 Circuits), 6-20
IC610MDL158, 24 V dc Source Output (16 Circuits), 6-26
IC610MDL16, Analog Output, 6-67
IC610MDL175, 115/230 V ac Output, 6-16
IC610MDL176, 115/230 V ac Isolated Output, 6-17
IC610MDL180, Relay Output (8 Circuits), 6-27
IC610MDL181, Relay Output Module, UL Listed, 6-74
IC610MDL182, Relay Output (16 Circuits), 6-29
IC610MDL185, 115 V ac Output Module, UL Listed, 6-75
Input/Output Circuitry, 1-7
Insert One Logic Element, 4-12
Installation, 3-2
  CPU, 3-7
  I/O, 3-9
  I/O Field Wiring, 3-10
  Power Connections, 3-10
  Programmer, 3-11
  Racks, 3-2
Installation of Programmer Cable, 3-13
Installation, Specifications, 3-1
Instruction Groups, 5-7
Internal Coils, 5-13
Introduction to Maintenance Procedures, 7-1
Introduction to Programming, 5-1

L

Ladder Diagram Format, 5-17
List of Fuses, 7-7
Location of Extra Memory Socket, 7-5
Logicmaster 1 Application Software, 1-1
Logicmaster 1 Family Application Software, 1-6
Logicmaster 1F Application Software, 1-1

M

Memory Size, 3-8
Monitor Counter Status, 4-13
Monitor CPU Logic, 4-10
Monitor Data Register Contents, 4-14
Monitor I/O Status, 4-12
Monitor Timer Status, 4-13

O

Operating Principles, 5-14
  Scanning, 5-14
Operation Sequences, 4-8
Operation With Peripheral Devices, 4-15
  Loading a Program, 4-18
  Recording a Program, 4-16
  Tape Recorder, 4-15
  Verifying a Program, 4-16
Optional Hardware, 2-8

P

Password Protection, 1-3
PC Operation, 4-1
PC Terminology, 1-8
Peripheral Devices, 2-9
Peripheral Devices, Operation, 4-15
Planning a PC System, 5-1
Portable Programmer, 1-1, 1-5
Power Flow, 5-17
Power Supply Limitations, 3-13
Printer Interface Unit, 2-11, 4-18
Printer Requirements, 4-19
  80/132 Column Selection Switch, 4-21
  External Power Supply Connector, 4-21
  Hardware Description, 4-19
  Hardware Features, 4-20
  Power Supply Select Switch, 4-21
  Sequence of Operation, 4-22
Program Checking, 4-7
Programmable Controller Concepts, 1-5
Programmer, 4-1
Programmer Cable, 3-11
Programmer Features, 4-2
  Address Data Display, 4-2
  Data Operation Keys, 4-6
  Editing Keys, 4-4
  Logic Display, 4-2
  Logic Keys, 4-3
  Mode Switch, 4-2
  Peripheral Jack, 4-7
  Shifted Functions, 4-5
  Status Display, 4-2
Programmer Functions, 5-15
Programmer Mount Assembly, 2-4
Programmer Tape Port, 2-4
Programming, 1-5
Programming Function Compatibility Guide, C-5
Programming Fundamentals, 5-7
Programming the Data Operation Instructions, 5-45
  Addition (+), BCD 4 Digit (F71), 5-53
  BCD (Binary to BCD (F86), 5-70
  BIN (BCD to Binary) (F85), 5-69
  CMPR (F70), 5-52

(Programming the Data Operation Instructions cont)

  D•AND (DATA AND) (F75), 5-61
  D•OR (DATA OR) (F76), 5-63
  D•OUT (F60), 5-50
  D•OUT1 (F61), 5-50
  D•OUT2 (F62), 5-51
  D•OUT3 (F63), 5-51
  D•OUT5 (F65), 5-52
  D•STR (F50), 5-47
  D•STR1 (F51), 5-48
  D•STR2 (F52), 5-48
  D•STR3 (F53), 5-49
  D•STR5 (F55), 5-49
  Decode (F82), 5-67
  Division (:), BCD 4 Digit (F74), 5-59
  Encode (F83), 5-68
  External Fault Diagnosis (F20), 5-71
  INV (F84), 5-68
  Multiplication (X), BCD 4 Digit (F73), 5-58
  Shift Left (F81), 5-65
  Shift Right (F80), 5-65
  Special Function Coils, 5-46
  Subtraction (-), BCD 4 Digit (F72), 5-56
Programming, Introduction to, 5-1
PROM Writer Unit, 2-12, 4-29
  Front Panel Features, 4-30
  Power Supply Select Switch, 4-31
  Sequence of Operation, 4-31
Proper Heat Dissipation, 3-2

R

Rack Description, 2-1
Rack Grounding, 3-3
Rack Mounting Dimensions, 3-2
Recommended Field Wiring Procedures, 3-15
Referencing Sequencer Contacts, 5-37
Relay Output (16 Circuits) IC610MDL182, 6-29
Relay Output (8 Circuits) IC610MDL180, 6-27
Relay Output Module, UL Listed IC610MDL181, 6-74
Remote I/O, 1-8
Removable Connector, 6-3

Replacement of Components, 7-3
Replacing a CPU, 7-3
Replacing a Rack, 7-3
Replacing I/O Modules, 7-4
Replacing the Battery, 7-4
Requirements, Hardware, 2-7
Routing of I/O Wiring, Typical, 3-11

S

Safety Considerations, 3-15
Search CPU Logic, 4-11
Sequencer Operation, 5-36
Series One Execution Times, 5-3
Series One Model E, 1-3
Series One Plus 3.7K, 1-3
Series One Plus Program Protection, 1-6
Series One Programmable Controllers, 1-1
Shift Register, 5-38
Operation, 5-40
References, 5-39
Shift Register References, 5-13
Significance of References, 5-7
Spare Parts and Components, 7-6
Special Function Coils, Use of, 5-13
Specifications for Installation, 3-1
Summary of I/O References for 8 Circuit Modules, 5-10
Summary of Programming References, C-4
Summary of References, 5-8
System Estimating, 2-7

T

Thumbwheel Interface IC610MDL105, 6-36
Timer and Counter, 5-30
Extending Timer/Counter Range, 5-34
Programming Counters, 5-32
Programming Timers, 5-30
Timer/Counter References, 5-30
Timer and Counter References, 5-13
Timer/Counter Setpoint Unit, 4-32
Example of Using Thumbwheel Inputs, 4-34
References for, 4-33
Remote Mounting, 4-33
(Timer/Counter Setpoint Unit cont)
Specifications, 4-33
Total Scan Time, 5-14
Troubleshooting Aids, 7-1
Types of Memory, 1-7
CMOS RAM, 1-7
PROM, 1-7
Typical I/O Terminal Configuration, 6-3
Typical Rack, 2-1
Typical Sequencer Logic, 5-37

U

UL Listed Products, 1-7, 6-71
Units of Load, 3-13
Units of Load Supplied by Rack, 3-13
Units of Load Used by Modules, 3-14, 3-15
Unlimited use of References, 5-18
Use of the Special Function Coils, 5-13
Using References for Data Operations, 5-44
Data Register References, 5-44
Entering a Constant Value, 5-44
Entering a Group Reference, 5-44
Timer/Counter References, 5-45

V

Valid System Configurations for I/O Points, C-6

W

Workmaster Industrial Computer, 1-1

GE Fanuc Automation North America, Inc., Charlottesville, Virginia